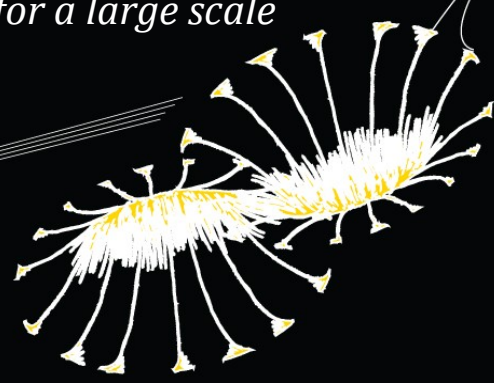





# Modeling the public order and safety domain

*“Optimal preparation of the managerial level for a large scale disaster”*



Pim Hornman



BUSINESS ADMINISTRATION  
MASTER INFORMATION MANAGEMENT

OKTOBER 12, 2012

UNIVERSITY OF TWENTE.



**BiZZdesign**



# Title page

Title: **Modeling the public order and safety domain**

Auteur: **P. W. H. M. Hornman, BSc**

Student number: **s0120146**

Master: **Business administration**

Track: **Information management**

University: **University of Twente**

Internship at: **BiZZdesign B.V.**  
**Capitool 15 (third floor)**  
**7521 PL Enschede**  
**The Netherlands**

**Graduation Committee:**

Supervisors UT: **Dr. M.E. Iacob**

**Dr. M.J. van Sinderen**

Supervisors BiZZdesign: **Dr. Ir. Dick Quartel**

## PREFACE

In November 2011, I started my graduation project at BiZZdesign B.V. in Enschede. BiZZdesign provided a pleasant working environment. The colleagues at BiZZdesign were all very friendly and helpful, which made me feel very comfortable from the moment I started. I feel that I have learned a lot during my time writing the thesis.

During the ten months that I was working on my thesis, I sometimes struggled finding solutions and writing down the ideas that I had. Therefore I would not have been able to finish the process without the help of several persons. First, I would like to thank my supervisor of BiZZdesign, Dick Quartel, for his helpful feedback, his shared expertise and patience with me. Second, I would like to thank Henry Franken, for giving me the opportunity to write my thesis at BiZZdesign and his feedback. In addition, I would like to thank Wilco Engelsman and Bas Burger, colleagues at BiZZdesign, for their support and collaboration during the TOKO project. During the TOKO project I received help from several employees of companies that I would like to thank for their expertise.

Furthermore, I would like to thank my fellow students at BiZZdesign for not only making my graduation-process fun, but also thank them for their help and feedback. I would also like to thank my supervisors from the University of Twente Maria Iacob and Marten van Sinderen for their support, advice, feedback, and their scientific insights and expertise.

This thesis means the end of my study period at the University and also my residency in Twente, therefore a special thanks to all the people I met over the seven year study period. Finally, I would like to thank my parents and my girlfriend for their unconditional love, support and motivation during my study years.

Pim Hornman

Enschede, October 2012

## MANAGEMENT SUMMARY

Crises and disasters always have a great impact on people that are involved. Even years after a disaster the physiological and sometimes physical consequences are still felt among those that were involved. The government has implemented various laws and risk assessments to prevent crises. Also crisis control has received a lot of attention over the last decade. Despite the implementation of these measures, past crises have shown that it is hard for crisis fighters to switch to an intensive cooperation with each other. The research reports of three large crises; the firework disaster in Enschede, the large Chemie-Pack fire and the new-year fire in Volendam, have shown the problems on a managerial level. These findings are supported by the reports of three large disaster exercises where the same problems are identified. This formed the problem-statement for this thesis.

- The need for more efficient and better training of crisis control at the managerial level
- The need for more oversight and insight in information that is needed for crisis control at the managerial level

Many organizations have benefited from Enterprise Architecture (EA) modeling and Business Process Modeling (BPM) in reducing organizational complexity. Tamm et al. recognizes four benefit enablers that show the advantage of EA; organizational alignment, information availability, resource portfolio optimization and recourse complementarity. Similar to business organizations, crisis organizations are characterized by structural complexity (many loosely coupled units), hierarchical relationships (many levels of command and reporting) and procedural rules (many constraints on how to act or operate). The advantages EA has on organizational alignment makes that the involvement of relevant people of the crisis organization is stimulated, which positively affects the knowledge of the presence of other roles and other partners. The information availability benefits may help to communicate between regions, and make that there is more uniformity about the interpretation of laws. Therefore the hypothesis of this research are as followed:

- Models can help training developers, trainers and trainees in creating, providing and receive training
- Models can help professionals at a managerial level in the public order and safety domain to gain more insight and oversight in the crisis organization

To be able to test these hypotheses, this research is concerned with answering the following main research question:

---

(MQ). "HOW CAN EXISTING MODELING TECHNIQUES BE USED TO MODEL THE DOMAIN OF PUBLIC ORDER AND SAFETY SO AS TO IMPROVE OVERSIGHT AND INSIGHT IN THE DOMAIN, AND TO HELP PROFESSIONALS WITH CREATING, PROVIDING, AND RECEIVE TRAINING AT THE MANAGERIAL LEVEL REGARDING DISASTERS AND CRISES?"

---

To research the use of modeling in the domain of public order and safety, the modeling language ArchiMate is used as basis to design the Public Order and Safety Modeling Language (POSML). During workshops with domain experts the requirements for the domain specific modeling language are recognized. A conceptual-model was created to conceptualize the way the domain works. Derived from the requirements the concepts and relationships were created that best describe the entities and relationships of the domain.

The examples that are created with POSML served as input for the validation part of this thesis. The validation is done using semi-structured interviewed with several experts in the field of public order and safety, modeling and game-creation. The examples are based on a scenario developed to form the basis for a virtual training game. The interviews focused on the rightfulness of the conceptual model and the usefulness of models in the domain.

According to the experts, the overall opinion of the show examples was positive. They argued that models were potentially useful for the field of public order and safety. They emphasized that the models were specifically useful for trainees, trainers and functionaries at a managerial level of crisis control. Moreover, it allows trainers to evaluate a training with the trainees and allows trainees and functionaries to have a clear overview of information lines and collaboration information. However to be able to confirm the hypotheses a more practical validation approach is required.

By collaborating with domain experts, POSML can be used to create stakeholder specific views to be used in the domain of public order and safety. This allows experts to compare the use of models in their work or training to their current working or training methods. This provides a more practical validation.

# Table of contents

Preface .....	iv
Management Summary .....	v
Chapter 1: Introduction .....	1
1.1 Background .....	1
1.1.1 The TOKO project .....	1
1.1.2 BiZZdesign .....	1
1.2 Problem statement .....	2
1.3 Proposed solution (hypotheses) .....	4
1.4 Research Objectives and Research Questions .....	6
1.4.1 Main research question .....	6
1.4.2 Knowledge questions .....	6
1.4.3 Development questions .....	7
1.4.4 Validation questions .....	7
1.5 Research Approach .....	7
1.5.1 Problem identification and motivation .....	9
1.5.2 Define objectives of a solution .....	9
1.5.3 Design and development .....	10
1.5.4 Demonstration .....	10
1.5.5 Evaluation .....	10
1.6 Report structure .....	12
Chapter 2: General crisis information .....	13
2.1 General Information Crisis .....	13
2.1.1 Definitions .....	13
2.1.2 Types of disasters .....	14
2.2 General Information Crisis Management .....	17
2.2.1 Definitions .....	17
2.2.2 Laws and legislation .....	17
2.2.3 Safety chain .....	18

2.2.4 Risk assessment .....	21
2.2.5 GRIP .....	21
2.2.6 Working netcentric .....	25
Chapter 3: Past Crisis and Multidisciplinary Crisis Exercises .....	26
3.1 Fireworks Disaster Enschede.....	26
3.1.1 Risk Control.....	26
3.1.2 Crisis control.....	27
3.1.3 Conclusions .....	28
3.2 Chemie-Pack .....	29
3.2.1 Risk Control.....	29
3.2.2 Crisis control.....	30
3.2.3 Conclusions .....	30
3.3 Volendam new-year bar fire .....	32
3.4 Large disaster exercises.....	32
3.4.1 Bonfire 2005.....	32
3.4.2 Voyager 2007 .....	34
3.4.3 Waterproef 2008.....	35
3.4.4 Conclusion .....	35
3.5 Conclusion .....	36
Chapter 4: Models .....	38
4.1 Modeling the crisis organization.....	38
4.1.1 Model definitions .....	38
4.2 Enterprise architecture.....	39
4.2.1 General information EA.....	39
4.2 State of the art in EA.....	43
4.4 Business process modeling.....	47
4.5 Models used in public order and safety domain.....	53
4.6 Conclusion .....	56
Chapter 5: Requirements for a conceptual model.....	57
5.1 Selecting a modeling technique .....	58



5.2 Requirements for a conceptual model .....	61
5.2.1 Requirements role and task recognition view.....	61
5.2.2 Requirements information management view.....	62
5.2.3 Requirements training view.....	62
Chapter 6: The Public order and safety modeling language .....	63
6.1 The Conceptual model.....	63
6.2 Explanation of the conceptual model.....	66
6.2.1 Visual adjustments .....	66
6.3.2 Explanation of the concepts .....	67
Actor.....	67
Role.....	68
Task.....	69
Learning goal.....	71
Scenario .....	72
Event.....	73
Competence .....	75
Training .....	76
Information object .....	77
6.2.4 Explanation of the relationships.....	78
Assignment Relationship.....	78
Aggregation Relationship.....	78
Realization Relation.....	79
Used By Relationship .....	79
Association relationship .....	79
Triggering Relationship .....	80
Flow relationship.....	80
Access relationship .....	81
6.2.5 The RACI-model Relationships .....	81
6.3 Example of use.....	82
6.3.1 Power outage scenario .....	82

6.3.2 Examples based on the scenario.....	85
6.3.3 Examples of the views .....	86
6.4 Chapter conclusion .....	90
Chapter 7: Validation.....	91
7.1 Type of research for evaluation.....	91
7.2 Data collection method .....	92
7.2.1 Documents.....	92
7.2.2 Semi structured interviews .....	93
7.3 Data analysis.....	93
7.3.1 Rightfulness conceptual models.....	93
7.3.2 Usefulness of models.....	96
Chapter 8: Further validation .....	98
8.1 Creation of the views.....	98
8.1.1 Role recognition view .....	99
8.1.2 Information management view .....	99
8.1.3 Training view.....	99
8.2 Conclusion .....	100
Chapter 9: Conclusions and discussion.....	101
9.1 Conclusions .....	101
9.2 Limitations.....	105
9.3 Recommendations & future work.....	106
References.....	107
Appendix A: Risk diagram .....	113
Appendix B: Overview of problems during crisis control.....	114
Appendix C.: Interview protocol.....	117
Appendix D.: Summary's of the interviews .....	120

# CHAPTER 1: INTRODUCTION

---

---

*This introduction starts with the description of the TOKO project, which is the main motivator for this research, and the company BiZZdesign, where the thesis work was carried out. This is followed by the problem statement, giving the motivation and a solution direction for the problems identified. The research objectives and research questions provide a structured way of solving the problems. The last part of this chapter discusses the research approach and thesis structure.*

## 1.1 BACKGROUND

This section describes the TOKO project and the company BiZZdesign.

### 1.1.1 THE TOKO PROJECT

The TOKO project is a project BiZZdesign participates in, which is initiated by the “Innovatie voor Maatschappelijke Veiligheid” (innovation for social security, IMV). IMV is a government-funded arrangement, which aims at improving national security with technical innovations. Together with several other partners, NIFV, Thales Nederland, TNO, the University of Twente, Novay and System Navigator, the main goal of the project is to conduct a web based training-tool. The goal of the TOKO project, which stands for “TrainingsOmgeving voor grootschalig multidisciplinair KetenOptreden” (training environment for large scale multidisciplinary chain performance, TOKO) is described as: “group training and group learning in a more cost-effective way (six times less cost) and a higher learning efficiency in a learning process which is needed for an optimal collaboration during large scale disasters and crisis.” [1:3] The challenge for BiZZdesign is to formally model the domain and learning processes as described by TNO and NIFV(partners in the TOKO project). The TOKO project offers a good opportunity to study the use of architecture and process modeling in a domain differing from the administrative domain where models are currently more extensively used.

### 1.1.2 BIZZDESIGN

BiZZdesign is a spin-off company of the Telematica Instituut, currently known as Novay, based on the results of a project called the Testbed-project. Testbed is a virtual testing environment for business processes. The goal of the project was to visualize, simulate and realize changes in processes, in a systematic and controllable way, using insightful models and structured methods. The project had a duration of five years and was conducted by ABP, the tax authorities, IBM, ING Group and the Telematica Instituut. After the project, BiZZdesign developed Testbed further and put the tool BiZZdesigner, conducted from the project, on the market successfully. Together with other developed tools, BiZZdesign offers integrated solutions which “consist of user-friendly tools, best practice models and methods, training and consultancy for”: [2]

- Enterprise architecture management;
- Business requirements management;

- Business process design and improvement;
- Business process management;
- Structured implementation and governance;

BiZZdesign is internationally recognized for its tools, consulting, and training in the field of process management and enterprise architecture. More recently BiZZdesign was recognized by Gartner, Inc. as leader in the Gartner Magic Quadrant 2011 for Enterprise Architecture [3]. The experience BiZZdesign has in modeling processes and applying enterprise architecture theories for various administrative companies is the reason for the IMV to contact BiZZdesign to participate in the TOKO project.

## 1.2 PROBLEM STATEMENT

The prevention and controlling of disasters has gained much attention of the Dutch government. Due to the large disasters that occurred in the beginning of this century: the firework explosion in Enschede and the large fire in the cafe “het Hemeltje” in Volendam. These disasters show that it is hard for parties involved in disaster control to switch to an intensive cooperation with each other, both at the operational and the managerial level [4].

The occurrence of disasters and crises are mostly unexpected and often across different administrative and geographical boundaries [5]. It is very important for the different managerial roles involved to closely work together, although it seems that this often is not the case. This is strengthened by the fact that most administrators have different interests regarding disaster control. Different responsibilities for example often lie with different ministers or chairmen and it is unclear who has the final responsibility and with whom there should be communicated [5]. A simple example of this is that no answer could be found to the question “who is in charge of the fire department in daily activities?”[6]. These unclaritys make preparing, analyzing and controlling a crisis and the coordination and cooperation on a managerial level a complex matter.

To create more clarity in crisis control in the Netherlands, the government passed a new law which is active since 2010, called Wet veiligheidsregio’s (safety regions act), with the intention to make it easier to control and command the different emergency services during a disaster. The law aims at: “An efficient and high quality organization of firefighting, medical assistance in accidents and disasters, and disaster and crisis management under one regional governance.” [7:8]. The law describes in detail what general tasks the managerial roles, involved in controlling a crisis have. It also describes who is in charge in the regions and which responsibilities those in charge have. The goal of this law is to make all the roles for the people at the managerial level clear.

A more recent example, the large scale fire at Chemie-Pack in Moerdijk in 2011, shows that the law does not have the desired effect yet. After research, it became apparent that there are various (managerial) aspects that can be improved in leadership, coordination and the direction of gathering information, on a national level [8]. The inspections done after the disaster revealed that the link between the regional and national level needs further research. Another aspect that appeared unsolved despite the new law is role-uncertainty. It became clear that many managerial officers find it hard to recognize and fulfill their supposed role during the collaboration of firefighting. This is especially true for high level officers, e.g. the mayor or the Queens’ Commissioner.

In addition, the new law brought a new way of communication. Working netcentric was introduced for all parties involved during a crisis, which meant that an online network is used to share crisis information with all partners. This new way of communicating was created to accelerate the gathering of information and create an overall picture of the crisis. All the information is shared via a common system which is used by all teams fighting the crisis. Therefore, to work netcentric, a correctly organized information management system is required.

It became apparent that working netcentric also does not result in the desired outcomes. During the fire at Chemie-Pack the new system was not operational for all regions involved. This resulted in a chaotic non-uniform picture of the disaster. Also most of the regions were not used to working netcentric, therefore several regions communicated using their own old systems, which also contributed to an incomplete picture of the disaster. The cause for the latter can be traced back to the lack of preparing and training of the managerial level for crisis control.

The need for training at a managerial level can also be explained with reference to the developments during a crisis. During a disaster or crisis catastrophic events often follow each other at a rapid pace. It is therefore important for the managerial level to quickly know how they should collaborate; how and with whom information should be shared and it is of critical importance to take rapid and correct decisions. It is very likely that the practice and training of fighting a large realistic disaster will positively affect the speed and quality of the decision making process. Moreover, the TOKO project also motivates the need for training more efficiently and with higher regularity.

Considering all the above we may conclude that, even though there has been a lot of attention for crisis control resulting in the creation of the new safety act and the introduction of netcentric working, these measures did not have the desired effect. Research of recent disasters showed that the crisis control is still lacking in communication. The "netcentric communication" and the law safety regions did not have the desired effect. The law was supposed to create uniformity and a clear role description among all parties involved. However this is not the case, especially among managerial functions. A logical conclusion of the latter is that the rules, legislation and other measures lack in oversight and demand a way to structure the information which is used to prepare for and respond to, a disaster.

It becomes clear that there are two leading problems in crisis control:

- |   |
|---|
| <p><b>Problem 1:</b> <i>Need for more efficient and better training of crisis control at the managerial level</i></p> <p><b>Problem 2:</b> <i>Need for more oversight of and insight in information that is needed for crisis control at the managerial level</i></p> |
|---|

Throughout this research the domain of public order and safety is viewed from the perspective of the decision-making authorities involved in a disaster. The work done at the operational level, working to prevent or control a disaster or crisis (e.g. put out fires, save victims etc.), is not considered. Hence the focus lies on the managerial problems in the public order and safety domain.

## 1.3 PROPOSED SOLUTION (HYPOTHESES)

### Need for training of the managerial level

The need for training, which is also emphasized by the TOKO project, calls for a system allowing multiple users to train while not present at the same location. For this training to be effective and for the learning curve to be as high as possible a realistic and well defined scenario is necessary. The difference between a real time training exercise with real fire, real people and the right feeling similar to an actual disaster, and a training exercise done remotely should be minimal. A clear scenario description is essential for the developers of a training tool to construct the scenario as realistic as possible.

Other information necessary for these developers is information about the trainees regarding learning competencies, responsibilities, task-descriptions etc. This is needed to correctly implement a training game, which trains the right tasks and improves the right competencies for the right trainee. To help structure training scenarios and the need for trainee information necessary to develop training software the use of models is proposed. Osterwalder et al. interpret the word model as follows [9]:

*“a simplified description and representation of a complex entity or process.”*

A scenario can be viewed as a certain process where often disastrous events follow each other rapidly and where the events that occur are unpredictable. The authors of the scenario need to communicate the important information that is considered in a scenario to the people making the (virtual) training. The use of models can provide a clear way of presenting the important events. Models can also provide a structured way of presenting trainee information. Not only will this help clarify certain scenarios and structure the information needed, but it will also aid software developers, training participant, trainers and other parties involved.

### Need for more oversight and insight

When models can represent the processes of a scenario in a structured and clear way, a logical reasoning is that models can also help bring more oversight and insight in the complex public order and safety domain. The domain is complex because it entails a lot of separate services (e.g. police department, firefighting department and medical department) which work together towards a unified goal namely controlling a crisis. A comparison can be made to regular firms or businesses, for example administrative businesses, where there are various departments, business units, different activities etc. Modeling concepts and standards used to clarify how a company does business can also be used to do the same for the public order and safety domain.

There are many different models used at many different companies to provide some sort of structured way in presenting processes or architecture of companies. Several examples of those models are:

#### Business models [9]:

*“A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences.”*

A shorter definition of a Business model [10]:

*“A business model describes the rationale of how an organization creates, delivers, and captures value”*

Enterprise architecture models [11]:

*Models used in: “(...) the design and realization of an enterprise’s organizational structure, business processes, information systems, and infrastructure”*

Process models[12]:

*“Description of a diagrammatic representation of the process, existing of different levels”*

Researchers who work on developing the model aspect of business models refer to a conceptualization of the way a company does business to manage complexity to an understandable level. This means that these researchers are trying to develop a meta-model to describe elements and relationships that can best describe the business of a company [11:20]. For modeling the public order and safety domain this means that the concepts and relationship that best describe the entities and relationships that exist in the domain should be researched to come up with a conceptual view. Next a meta-model defines the words and sentences used to describe this view.

In conclusion we propose 2 hypotheses that are related to the problem statement. The first hypothesis is in regard to the first problem about training and the second hypothesis is in regard to second problem about more oversight and insight.

**Hypotheses:**

**Hypothesis 1:** *Models can help training developers, trainers and trainees in creating, providing and receive training*

**Hypothesis 2:** *Models can help professionals at a managerial level in the public order and safety domain to gain more insight and oversight in the crisis organization*

## 1.4 RESEARCH OBJECTIVES AND RESEARCH QUESTIONS

In the previous two sections two problems were recognized and two hypotheses were formulated. To test the hypotheses a main research question is formulated with several sub questions.

### 1.4.1 MAIN RESEARCH QUESTION

The main objective of this thesis is best described as a question, therefore the main objective and main research question are the same.

*Mq1: How can existing modeling techniques be used to model the domain of public order and safety so as to improve oversight and insight in the domain, and to help professionals with creating, providing, and receive training at the managerial level regarding disasters and crises?*

To answer this main research question several sub questions are formulated. There are three types of sub questions identified. The first section contains knowledge questions. These are questions that provide a structured way to come to a literary substantiated prove for the problem formulated in the problem statement and also provides a way to research possible modeling techniques that can be used to validate the hypothesis. The second set of sub questions are development questions. These questions provide a structured way for the development of a conceptual model that provides a modeling basis for the hypothesis validation. The third section provides questions that structure the validation of the hypotheses.

### 1.4.2 KNOWLEDGE QUESTIONS

#### Problem recognition

First, the recognition of the problems regarding disaster control in past disasters and crisis occurred in the Netherlands is researched. By answering these questions a literary substantiated prove is provided for the problems discussed in the problem statement.

*Sq1: How is crisis control currently organized in the Netherlands?*

*Sq2: What problems occur at a managerial level during the response on a disaster and crisis?*

*Sq3: What solutions have been proposed to solve these problems?*

#### Solution investigation

Second, different modeling techniques are researched which can form a basis for modeling the public order and safety domain. By answering these questions, possible modeling techniques are recognized that can be used to validate the hypotheses. This includes recognizing modeling techniques already used in the public order and safety domain.



*Sq4: What modeling techniques are at this moment state of the art and are candidates to be used to model the disaster control domain?*

*Sq5: What modeling techniques are currently used in the domain of disaster control?*

### 1.4.3 DEVELOPMENT QUESTIONS

The third objective of this thesis is to create a conceptual model for modeling the different aspects important in regard to the domain. The creation of a conceptual model provides a basis that can be used to create useful models, as researched in the previous step. The concepts and relations necessary to describe the public order and safety domain are recognized, i.e. requirements, and a conceptual model is constructed.

*Sq6: How can existing modeling techniques be used to model and analyze these problems and solutions?*

*Sq7: What extensions/improvements are necessary for current modeling techniques to correctly model the public order and safety domain?*

### 1.4.4 VALIDATION QUESTIONS

Fourth and final, the validation questions are formulated to test the hypothesis. The models that are created form the context for this validation. By answering these questions the developed conceptual model will be validated.

*Sq8: Is the developed conceptual model suitable in terms of used concepts?*

*Sq9: Do these models help to...*

- *...better understand the problems?*
- *...analyze the proposed solutions and support?*
- *...solve the recognized problems?*

## 1.5 RESEARCH APPROACH

In their paper, Peffers, Tuunanen, Rothenberger, and Chatterjee [13] motivate, present and demonstrate the use of a research methodology called 'design science research methodology'. They state that design science is an applied research discipline that uses theory from other disciplines to solve organizational problems using information technology. Peffers et al. [13] further states that the dominant research paradigm that is currently often used to produce and publish valid research is done using traditional descriptive research which is borrowed from social and natural science. It could be argued that traditional research output, mostly explanatory, is not applicable to the solution of problems encountered in research and practice [13]. According to Hevner, A.R., March, S.T., and Park, J. [14], design science:

*"creates and evaluates IT artifacts intended to solve identified organizational problems"[14:77]*

Even though the proposed solution in this thesis is not in the nature of IS artifacts, it does propose a more practical solution, in terms of a conceptual model and the application thereof. It is for this reason that design science research methodology is partly applied here to structure the thesis and to define the research approach. That is, several steps of the methodology proposed by Peffers et al. [13] are used and combined with traditional ways of doing research and validation derived from the field of social research.

For the design science research methodology, as proposed by Peffers et.al. [13], five research activities are recognized:

<i>Research activities for a design science research methodology</i>		
Activity nr.	<b>Peffers activity description</b>	<b>Adapted activity description</b>
<b>Activity 1</b>	Problem identification and motivation	Problem identification and motivation
<b>Activity 2</b>	Define objectives for a solution	Define objectives for a solution 1. Define objective for a solution. (hypothesis) 2. Discuss possible solutions 3. Make a substantiated choice
<b>Activity 3</b>	Design and development	Design and develop 4. Obtain required input 5. Identify concepts and relations 6. Develop conceptual model
<b>Activity 4</b>	Demonstration	Demonstration: 7. Show use of conceptual model, as input for activity 5
<b>Activity 5</b>	Evaluation	Verify the solution 8. Use Qualitative validation method(s) to gather data and validate conceptual model

TABLE 1: RESEARCH ACTIVITIES FOR A DESIGN SCIENCE RESEARCH METHODOLOGY

These five activities are used as basis for the research approach of this thesis. Figure 1 shows the five activities, in general, that are done throughout the thesis. The figure will be used in every chapter to indicate what activity is done in each chapter. Figure 2 is an extension on the figure shown below, and shows in more detail what every activity step entails.



FIGURE 1: GENERAL PROCESS STEPS

### 1.5.1 PROBLEM IDENTIFICATION AND MOTIVATION

The problems that occur in the public order and safety domain are the reason for this research. These are

defined and structured as to give a clear overview for the next phase of proposing a solution. The literature used to find these problems forms the first part of the literature part for this thesis. The way of collecting this literature material is done using Google, governmental websites and websites containing the reports of research committees. Another source for the documents is the NIFV, which is a Dutch institute for physical safety [15] and is also a partner in the TOKO project. Table 2 shows the keywords used in the search for literature. Note that most keywords described in table 2 were used in their Dutch translation since this part of the literature mainly comes from Dutch sources.



Keyword	Goal
<b>Chemie-pack</b>	<b>Literature about disaster at Chemie-Pack</b>
<b>Firework disaster, Enschede</b>	<b>Literature about the firework disaster in Enschede</b>
<b>Fire Volendam</b>	<b>Literature about the fire in Volendam</b>
<b>Crisis management</b>	<b>Literature about crisis management</b>
<b>Crisis control</b>	<b>Literature about crisis control</b>
<b>Disaster control</b>	<b>Literature about disaster control</b>
<b>GRIP</b>	<b>Literature about GRIP scaling levels</b>
<b>OOV</b>	<b>Public order and safety (leading domain knowledge)</b>

TABLE 2 MAIN KEYWORDS USED FOR OBTAINING LITERATURE FOR THE PROBLEM IDENTIFICATION AND MOTIVATION

### 1.5.2 DEFINE OBJECTIVES OF A SOLUTION

To define objectives of a solution various options should be considered. The hypotheses indicate that the solution

will be sought in modeling. This step represents the search for a suitable modeling technique. To be able to find a suitable technique a literary research to the state of the art of modeling techniques is required. A literature search has been performed using Google scholar, Scopus and Web of Science. Various keywords in different combinations are used in the search for scientific literature, these keywords are listed in table 3.



Keyword	Goal
<b>Modeling techniques</b>	General literature about modeling
<b>Enterprise architecture modeling</b>	Literature about enterprise architecture and modeling techniques used for it
<b>Business process modeling</b>	Literature about business process modeling
<b>TOGAF</b>	Literature about TOGAF
<b>UML</b>	Literature about UML
<b>BPMN</b>	Literature about BPMN
<b>Models in public order and safety</b>	Literature about currently used models in the domain

TABLE 3 MAIN KEYWORDS USED FOR OBTAINING LITERATURE FOR THE STATE OF THE ART IN MODELING TECHNIQUES

### 1.5.3 DESIGN AND DEVELOPMENT

In order to be able to validate the hypotheses stated in section 1.3 it is necessary to come up with requirements

for the creation of a conceptual model. By developing a conceptual model for the domain, models can be created, which are needed to prove the hypotheses.



The requirements are formulated and form the design demands of a conceptual model. The way the requirements are elicited is through brainstorm sessions that used several documents as input. The brainstorm sessions are discussed in more detail in chapter five. The design and development step will represent the creation of a conceptual-model taking the requirements into account. The implementation of the conceptual model is done by BiZZdesign. Even though the implementation is not the main issue, but rather the execution of the development, it is done to be able to come up with a (visual) representation of the proposed solution. This visual representation, i.e. various views, enables us to give examples to domain expert. Moreover, these form the input for the demonstration step.

### 1.5.4 DEMONSTRATION

The demonstration step will provide input for the

evaluation step. To be able to evaluate the solution, i.e. conceptual model, several examples of use are provided. By doing so an indication is given of how the proposed conceptual model seeks to solve the recognized problems. These examples are used as input for the interviews which are conducted in the next research step.



### 1.5.5 EVALUATION

Since the proposed solution will not yet be used in the

public order and safety domain we will not be able to evaluate it in the original sense of the word. Therefore the evaluation step will represent the validation of the conceptual model. This validation is done using semi structured interviews. Chapter seven elaborates more about this research step, discussing validation and data-collection. Chapter eight provides a way to validate the proposed model further, which due to time constraint cannot be executed while writing this thesis.



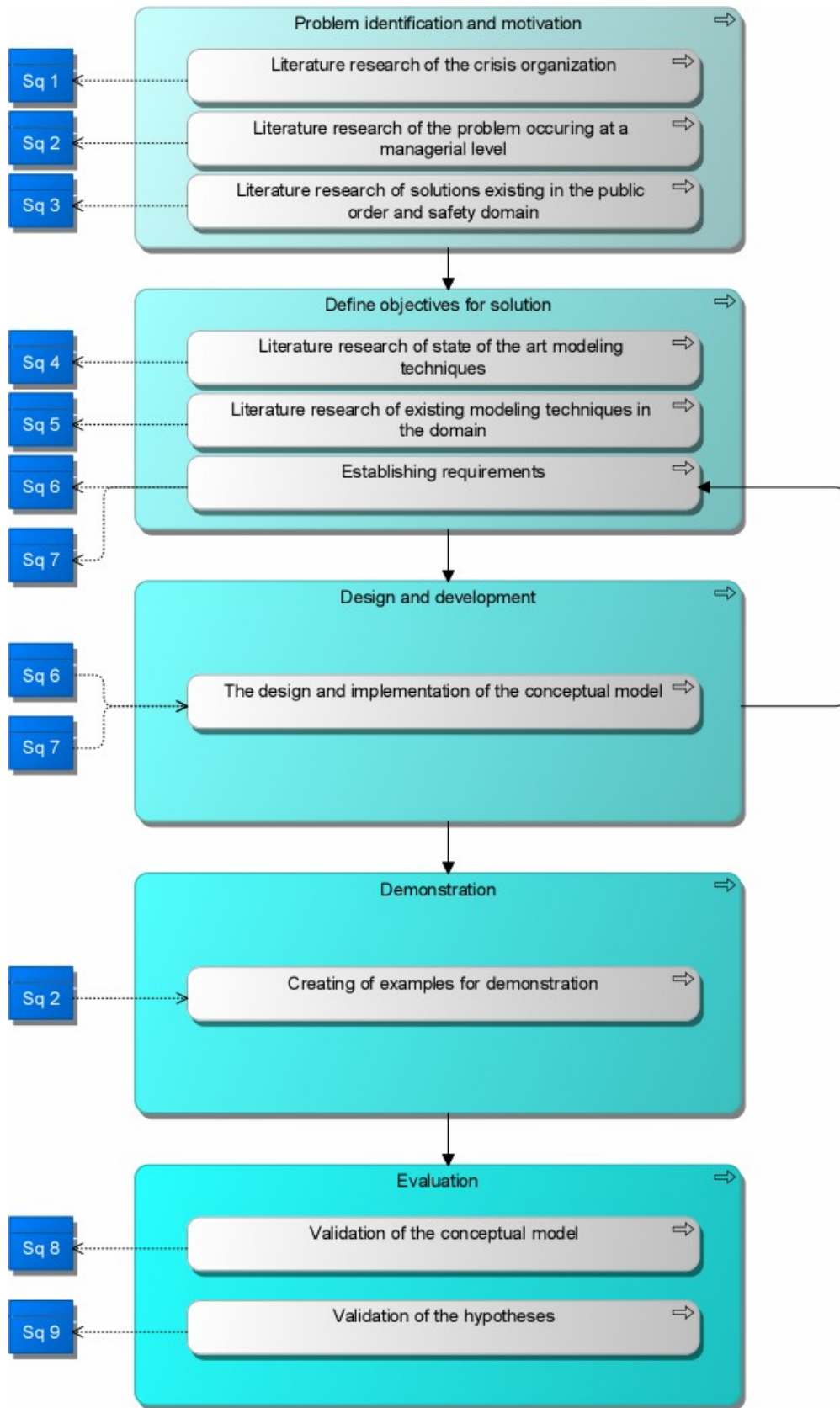


FIGURE 2: VISUAL REPRESENTATION OF THE RESEARCH APPROACH

## 1.6 REPORT STRUCTURE

Chapter 1 explains the background motivation and method for the thesis. Chapter 2 gives required background and required knowledge of the public order and safety domain, including the terms used in this thesis and the general laws and legislation in the Netherlands. The problems that are recognized at the managerial levels in the domain and form the motive for this research are discussed in chapter 3. Chapter 4 gives an overview for the state of the art in modeling techniques including the tools and techniques used at BiZZdesign. In chapter 5 the requirements are formulated which allows us to create a conceptual model that is used to model the domain. Chapter 6 consists of the development stage which discusses the implementation of the concepts and relationships. Chapter 7 describes the validation method in more detail and gives the conclusion about the semi-structured interviews. A method to further validate the proposed solution is given in chapter 8. Lastly, chapter 9 contains the conclusions, limitations, future work and recommendations.



# CHAPTER 2: GENERAL CRISIS INFORMATION

---

*The occurrence of disasters will always have great impact on the people involved. Even years after a disaster the physiological and sometimes physical consequences of a disaster are still felt among those that were involved. Also the landscape and physical surrounding of a disaster site will often change and never be the same. This chapter describes what a crisis is and how the Netherlands deals with a crisis. The chapter consists of two parts. The first part discusses crises in general. The second part discusses crisis control in general. The purpose of this chapter is to introduce the various terms, rules, measures, roles, and (managerial) functions that play a part in the public order and safety domain which are necessary to allow the reader to understand the rest of the thesis.*

## 2.1 GENERAL INFORMATION CRISIS

### 2.1.1 DEFINITIONS

Situations requiring the need for police, fire fighters or medical assistance exist in different gradations. Each gradation represents a different level of the seriousness and magnitude of some event. Throughout this thesis several terms regarding such events are defined, the most important and general terms are described below.

An *incident*, even though there is no official definition of an incident, can best be described as [16]:

*A small event that disturbs the public order in some way and is relatively easy to solve.*

A *disaster* is described by the Dutch law as [17]:

*An event that creates a serious disturbance of public safety in which the lives and health of many people, the environment or major material interests are seriously threatened or harmed, and involving the coordinated use of services and organizations of various disciplines is required to eliminate the threat or reduce adverse effects.*

A *crisis* however is more severe than a disaster and is described by the national manual for crisis decision making as [18]:

*An event in which national security is at stake because one or more vital interests are affected and the regular structures and / or resources are not sufficient to maintain stability.*

While reading literature about crisis, it became apparent that the words crisis and disaster are often not used in accordance with the definition stated above. Also the way that the word crisis is used in regard to the problems recognized and the provided solution, ask for a general definition that is more suitable. Therefore a general definition for the word crisis is given that will be used throughout this thesis to ensure consistency.

The definition of a crisis that will be used throughout this thesis is as followed:

*“An event that creates a serious disturbance of public safety, where national security might be at stake and the coordinated use of services and organizations of various disciplines is required to eliminate the threat or reduce adverse effects.”*

### 2.1.2 TYPES OF DISASTERS

In a document developed by the Dutch ‘Ministry of the Interior and Kingdom Relations’ 18 disaster types are distinguished [19]. These types can be further divided into 7 general types:

Disaster types
<b>1. Disasters regarding traffic and transportation:</b> <ol style="list-style-type: none"> <li>1. Aviation disaster</li> <li>2. Disaster on water</li> <li>3. Traffic disaster</li> </ol>
<b>2. Disasters with chemicals:</b> <ol style="list-style-type: none"> <li>4. Disaster involving flammable / explosive chemicals</li> <li>5. Disaster with toxic substance</li> <li>6. Nuclear disaster</li> </ol>
<b>3. Disasters regarding public health:</b> <ol style="list-style-type: none"> <li>7. Threat to public health</li> <li>8. Epidemic disease</li> </ol>
<b>4. Disasters regarding infrastructure:</b> <ol style="list-style-type: none"> <li>9. Disasters in tunnels</li> <li>10. Fire in large buildings</li> <li>11. Collapse of large buildings</li> <li>12. Failure of utilities</li> </ol>
<b>5. Disasters regarding the public:</b> <ol style="list-style-type: none"> <li>13. Panice in crowds</li> <li>14. Large scale disturbances</li> </ol>
<b>6. Natural disasters:</b> <ol style="list-style-type: none"> <li>15. Floods</li> <li>16. Natural fires</li> <li>17. Extreme weather</li> </ol>
<b>7. Disasters in other countries:</b> <ol style="list-style-type: none"> <li>18. Disaster in other countries involving Dutch nationalities</li> </ol>

TABLE 4: DIFFERENT DISASTER TYPES AS IDENTIFIED BY THE MINISTRY OF THE INTERIOR AND KINGDOM RELATIONS



Next to the classification of disasters, there is also a classification of a vital infrastructure, divided into vital sectors. This classification entails those products, services and their processes, which if they fail can create social disruption, because there are many victims, large economic damage, or the time for recovery of those products or services will take too long and no alternatives exist. The importance of the collaboration of government and business is stressed by the fact that 80% of these vital sectors are managed by various companies [20]. Table 5 shows these 12 vital sectors and 31 products or service.

The recognized vital sectors		
Sector	Product or Service	Responsible ministry
<b>Energy</b>	1. Electricity 2. Natural gas 3. Oil	Economic Affairs
<b>Telecommunications/ICT</b>	4. Fixed telecommunications facility 5. Mobile telecommunications facility 6. Radio communications and navigation 7. Broadcasting 8. Internet	Economic Affairs
<b>Drinking water</b>	9. Drinking water provision	Ministry of Housing, Spatial Planning and the Environment
<b>Food</b>	10. Food provision / safety	Ministry of Agriculture, Nature and Food Quality
<b>Health</b>	11. Urgent care / other hospital care 12. Medicines 13. Vaccines 14. Nuclear medicine	Ministry of Health, Welfare and Sport
<b>Financial</b>	15. Payment service / payment structure 16. Government financial transfer	Ministry of Finance
<b>Managing surface water</b>	17. Manage water quality 18. Manage water quantity	Ministry of Transport, Public Works and Water Management
<b>Public order and safety</b>	19. Maintaining public order 20. Maintaining public safety	Ministry of the Interior and Kingdom relations
<b>Legal</b>	21. Justice and detention 22. Law enforcement	Ministry of Justice
<b>Public administration</b>	23. Diplomatic communications	Ministry of the Interior and Kingdom

	24. Government information provision 25. Armed Forces 26. Decision-making public administration	relations
<b>Transport</b>	27. Schiphol main port 28. Port of Rotterdam 29. Main roads and major waterways (National Infrastructure) 30. Rail road	Ministry of Transport, Public Works and Water Management
<b>Chemical and Nuclear Industry</b>	31. Transport, storage and production / processing of chemical and nuclear substances	Ministry of Housing, Spatial Planning and the Environment

TABLE 5: VITAL SECTORS

Another distinction made by Dutch government is in ‘vital interests’. There are five vital interests recognized, which cannot be seen separately because mostly there will be a close correlation between them [21]. National security will be at stake if the vital interests are threatened in a way is (potentially) causes social disruption.

Vital interests	
Vital interest	Description
<b>Territorial security</b>	The undisturbed functioning of the Netherlands as an independent state at large, and the territorial integrity in the narrow sense.
<b>Economic security</b>	The undisturbed functioning of the Netherlands as an effective and efficient economy.
<b>Ecological safety</b>	Having enough self-healing ability of the environment if affected.
<b>Physical security</b>	The undisturbed functioning of humans in the Netherlands and its environment.
<b>Social and political stability</b>	The undisturbed survival of a social climate in which groups of people get along and can coexist within the framework of constitutional democracy and shared values.

TABLE 6: VITALS INTERESTS

To be able to cope with the different types of disasters, vital interests and vital infrastructure, several phases of crisis management are implemented in the Dutch law. The next section elaborates on these phases, and other governmental measures taken to prevent and control crises.

## 2.2 GENERAL INFORMATION CRISIS MANAGEMENT

The time location and magnitude of a disaster are never the same and are always unpredictable. Despite their unpredictability, the government tries to minimize the risks of disasters. With rules, legislation, fire-safety codes, risk assessments, regular checks of the compliance for companies of the rules and laws, the government aims to prevent the occurrence and impact of disasters. This section will give an overview of governmental efforts to prevent disasters. This includes the 'safety chain', risk assessment, general prevention and the laws and legislation existing in the Netherlands regarding disaster prevention.

### 2.2.1 DEFINITIONS

Crisis management ("crisisbeheersing") from [22]:

*All measures and facilities, including the preparation thereof, taken by the municipality board or the board of the region for preserving the public order, and if applicable in cohesion with other measures and facilities taken as basis of another enforced law regarding a crisis.*

Crisis control ("rampenbestrijding") from [22]:

*All measures and facilities, including the preparation thereof, taken by the municipality board or the board of the region regarding a disaster, prevention of a disaster, and limiting the consequences of a disaster.*

The difference between the two definitions is that crisis management considers the entire safety chain, thus including risk assessment, where crisis control considers the latter part of the safety chain. The safety chain is discussed in more detail in section 2.2.3.

### 2.2.2 LAWS AND LEGISLATION

With the disasters that occurred in the period 2000 – 2010, the Dutch government developed new laws and legislation surrounding crisis prevention. This resulted in 'the law safety regions' ("Wet veiligheidsregio's", (Wvr)). This law regulates "an efficient and high quality organization of the fire service, medical assistance in accidents and disasters, disaster control and crisis management under a regional government." [23] The law includes managerial embedding and basic requirements of emergency services, which shows what tasks the board of a safety region has, and what the minimum requirements for social workers are, like the regional fire and medical services, and the material they use.

The law divides the Netherlands in 25 regions which combines several municipalities in that region, Figure 3 shows this division. Each region arranges the approach of large disasters. The reason the government decided to create the different regions is because of the past disasters which showed that municipalities were too small and often not able to prepare for large fires and disasters [24]. In a certain region municipalities work together with several other services, called 'crisis partners', to, with their knowledge and expertise, aid in the controlling of a crisis. The other services that participate are dependent on the type of disaster. If water is involved, for example a levee breach, the water authorities will play a role. A disaster offshore will involve the Coastguard etcetera. Other examples of

services that might be involved are the Red Cross, canine search-and-rescue teams and the Salvation Army [25].

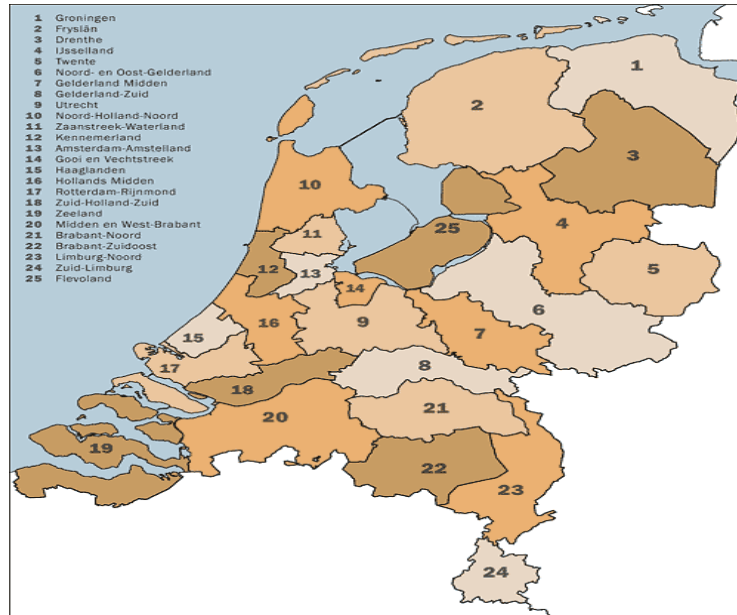


FIGURE 3: MAP OF THE NETHERLANDS AND THE DIVISION IN REGIONS

The board of a region consists of all the mayors of the municipalities in the region. The law safety regions further dictates that the board of the security regions makes several documents about crisis control, which are meant to describe the plans for different situations. These are a regional risk profile, a policy, a crisis plan, and an emergency response plan [25]. The next section describes some of these plans and what they encompass.

### 2.2.3 SAFETY CHAIN

This section describes the safety chain, which is based on [26] and is an initiative of the national institute for public order and safety. *Crisis management* is the term used to describe all activities done in the safety chain. The measures and procedures in place to prevent a disaster are collectively called the ‘safety chain’. The safety chain recognizes different phases in crisis management that we will discuss here. Figure 4 gives an overview of these phases. At the most general level of crisis management a division is made in two main phases; risk control and crisis control.

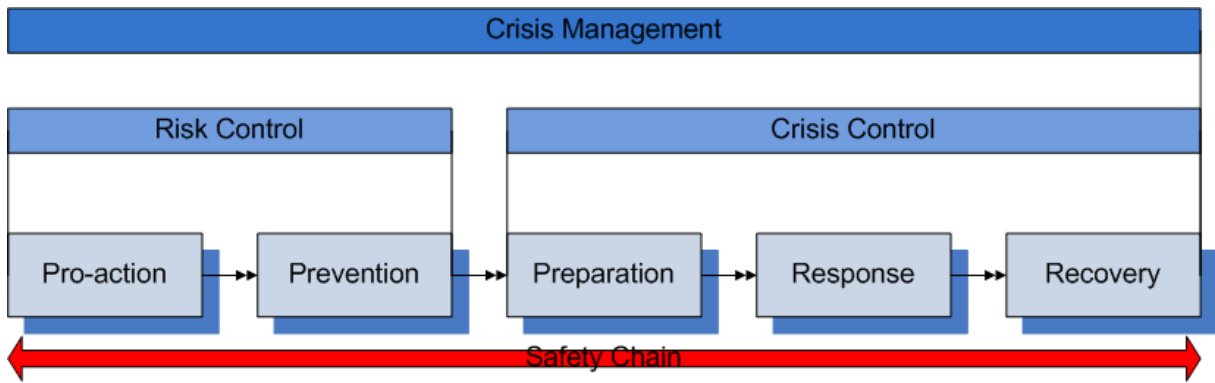


FIGURE 4: THE SAFETY CHAIN

The *risk control phase* is where the risks are recognized and categorized and where measures are taken to prevent a crisis from occurring. This main phase is further divided in a pro-action phase and a prevention phase. *Pro-action* is the structural prevention of unsafe situations. This phase focuses on identifying risks, analyzing risks and creating risk profiles, the latter will be more elaborately discussed in section 2.2.4. The *prevention* phase provides measures to minimize the risk recognized in the pro-action phase. These measures consist of rules, legislation, and demands in permits for buildings, storage and transportation of dangerous goods etc.

The *crisis control phase* is divided in a preparation phase, response phase and recovery phase.

#### Preparation phase

The preparation phase entails the preparation for large incidents and disasters. This starts with the risk profiles created in the pro-action phase. Regarding these risk profiles a risk policy is created by the regional board, which entails the entire safety chain including pro-action and prevention phases. This policy is the basis for the more specific plans for crisis control and consists of two types of plans; policy- and organization-plans and control-plans focused on the actual crisis control. Next in the preparation phase is the alignment of all services involved in disaster control, followed by an evaluation step considering the plans. Figure 5 shows the preparation phase.

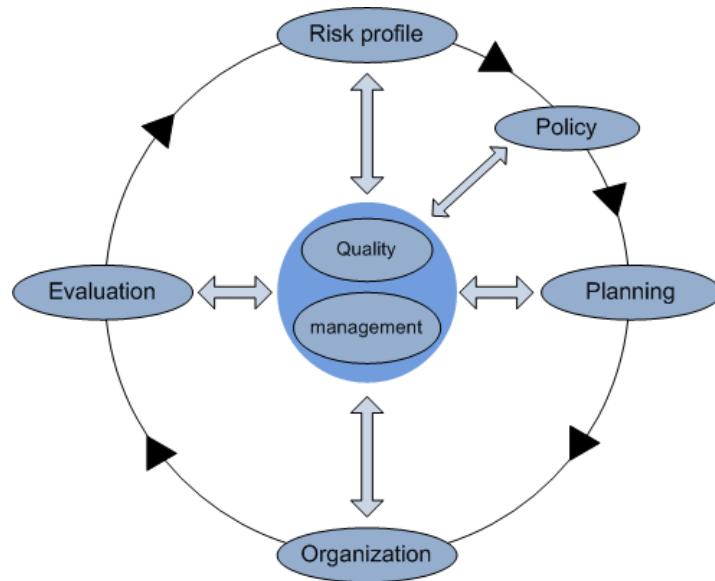


FIGURE 5: THE PREPARATION PHASE

Response phase

The response phase is the actual response to, and control of, a crisis. However the practical actions to be taken during the response are not described in the previous phase, these actions are dictated by those plans. During the response phase the scaling of the crisis is very important and is done using the GRIP scaling 'mechanism', which will be further explained in section 2.2.5. It is important during the response phase for all services involved to quickly change from the regular daily organizations to a coordinated multidisciplinary crisis control organization, this is represented by Figure 6.

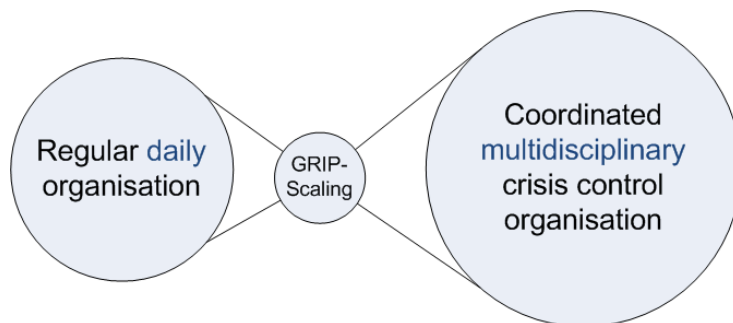


FIGURE 6: RESPONSE PHASE

Recovery phase

The recovery phase, or aftercare phase, is the final phase of the safety chain in crisis management. The recovery phase entails the measures necessary to return to the 'normal state' after the crisis. The phase can still be active long after the crisis, and often asks for the establishment of an information and advice center.

## 2.2.4 RISK ASSESSMENT

Every country has numerous areas that can be threatened in various ways, e.g. large fires, flooding or a flu epidemic. The consequences of threats and the chance of occurrence can be limited and people can prepare for them. As part of the new aforementioned 'law safety regions' it is made obligatory for every region to make and maintain a 'risk profile'. The goal of these profiles is for the administrative safety board to be able to make strategic decisions on the joint policy and to reduce risk and be better prepared for disasters and crises.

To map and visualize threats the Dutch government has developed a "measuring scale" to categorize different kind of threats [27]. This measuring scale is mainly used to make risks for national security comparable and to enable prioritization of measures. The scale consists of seven themes which are used in the strategy 'National Security' [27].

- Climate change
- Energy Security
- Polarization and radicalization
- Interweaving upper and lower world
- ICT failure
- Large accident
- Scarcity

The resulting risk diagram shows the probability and impact of the possible scenarios. Several scenarios are not only highly likely but also have a fierce impact factor, showing the importance to attempt to prevent and to be prepared for these threatening disasters. Appendix A shows the risk diagram for the Netherlands from 2010.

The disasters that have occurred in the Netherlands and new legislation were the reasons to create a risk assessment website called the riskmap [29]. This website combines all regional risk profiles and shows a map of the entire country containing possible risk hazards. The riskmap describes the risks and shows what they are, what danger the population living in the area could be in and what protection there is in the event of a crisis [28].

## 2.2.5 GRIP

In 2006 the Dutch government developed a national reference framework which uniformly describes the regional scaling and crisis management structure of the emergency services working together. The GRIP reference frame stands for Gecoördineerde Regionale Incidentbestrijdings Procedure ("Regional Incidents Reduction Procedure") [29] and is meant to ensure a good coordination during crisis control on a managerial and operational level. The procedure describes which teams are active, the composition of the teams, and the communication and command paths between them. GRIP distinguishes four levels which are more or less dependent on the severity of a crisis. Table 7 shows the different operational and managerial teams involved during the

different levels of GRIP. Table 8 lists the 4 GRIP levels and gives an indication on when they become active [30].

<b>Teams involved in the crisis organization (all GRIP levels)</b>	
<b>Abbreviations</b>	<b>Meaning</b>
<b>GMK</b>	Municipal report room
<b>CoPI</b>	Coordination place of the incident: handles the source control (e.g. putting out fire, taking care of the injured)
<b>ROT</b>	Regional operational team: controlling of source and effects
<b>GBT</b>	Municipality policy team: supports the mayor in GRIP 3 when the mayor is chief disaster control
<b>RBT</b>	Regional policy team: supports the chairman of the safety region (usually the mayor of the biggest municipality)
<b>NCC</b>	National Crisis Centre. The NCC makes sure that every manager and crisis-professional always has the most recent information during a crisis. They are 24 hours a day alert for happenings that can be a threat for national security. [31]
<b>PCC</b>	Provincial crisis center. Giving advice to the CdK
<b>CdK</b>	The Queens Commissioner

TABLE 7: TEAMS INVOLVED IN THE CRISIS ORGANIZATION (ALL GRIP LEVELS)

<b>Explanation GRIP levels</b>	
<b>GRIP level</b>	<b>Becomes active</b>
<b>GRIP 0/Routine</b>	Active during normal daily routines of the operational services
<b>GRIP 1</b>	Active when only source control is needed
<b>GRIP 2</b>	Active when source and effects control are needed
<b>GRIP 3</b>	Active when there is a threat to the wellbeing of (large groups of) the population
<b>GRIP 4</b>	Active when expansion of the treat expands across municipal boarders, with the possibility of scarcity

TABLE 8: GRIP SCALING EXPLAINED, BASED ON [30]



## GRIP 1

GRIP 1 is initiated when an incident only affects the source and not the direct surroundings of the source, and the incident requires multidisciplinary collaboration. At this level the CoPI is in charge and the mayor is informed of the incident.

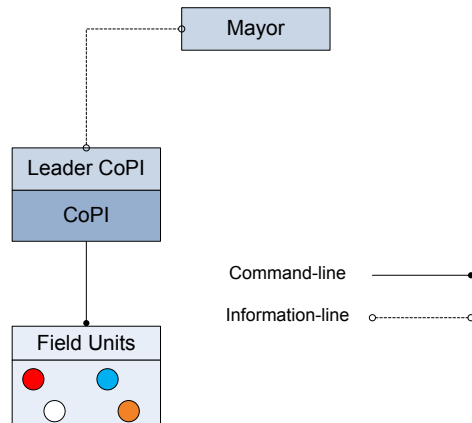


FIGURE 7: GRIP 1 [30]

## GRIP 2

When structural coordination is necessary and the incident affects the direct surroundings of the incident source, GRIP 2 is initiated. During GRIP 2 the ROT team is started and the operational leader takes place in this team. The operational leader is in charge of the crisis control organization. The mayor is informed and he enforces the GRIP level.

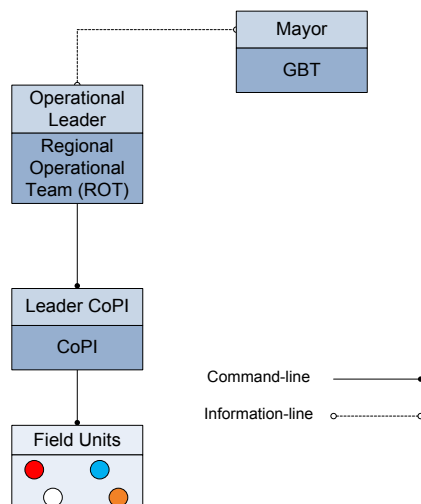


FIGURE 8: GRIP 2 [30]

### GRIP 3

When GRIP 3 is initiated there is a threat to the wellbeing of the population. Starting from this GRIP level the mayor is the managerial contact and is in command of the crisis control. The operational leader takes order from the mayor. The mayor is supported and advised by the GBT.

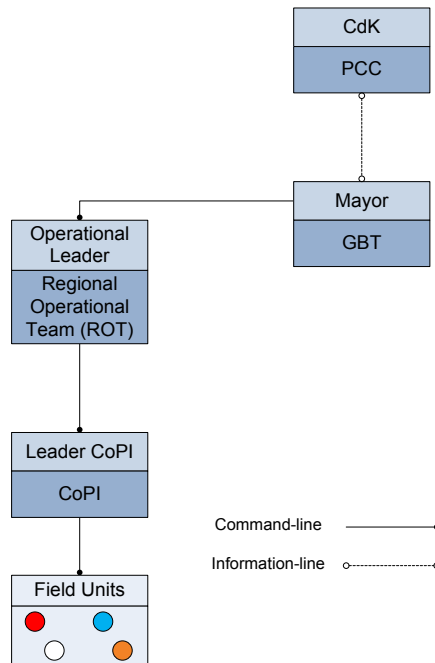


FIGURE 9: GRIP 3 [30]

### GRIP 4

The final GRIP level, GRIP 4, is initiated when the consequences of the incident expands across municipal borders, with the possibility of scarcity. When this happens the 'law safety regions' dictates that the chairman of the region becomes managerial coordinator. He or she is supported by the RBT and gives tasks to the operational leader on behalf of the mayor.

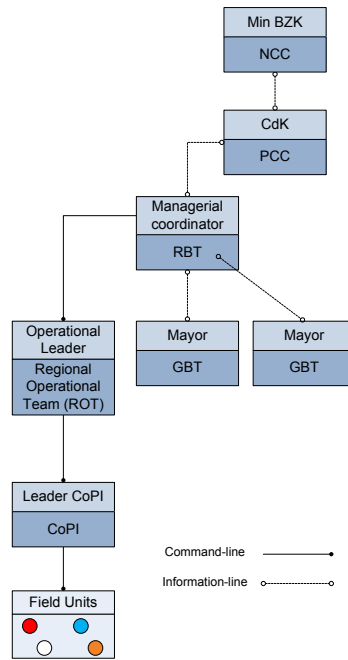


FIGURE 10: GRIP 4 [30]

## 2.2.6 WORKING NETCENTRIC

To support the regions with their communications among teams ‘working netcentric’ was created. It meant another way of working in terms of handling the crisis information. The reason for working netcentric was that other ways of working cost too much time to accurately inform all services involved during a crisis. Their view of what is happening often differs from each other.

Working netcentric uses an online network to share information instead of hierarchical lines to communicate information. This will lead to a constantly up-to-date picture of the situation; resulting in quicker decision making, effectively distribution of emergency personnel and goods, and informing the citizens faster, which eventually leads to less damage, fewer victims and faster recovery of the normal situation.

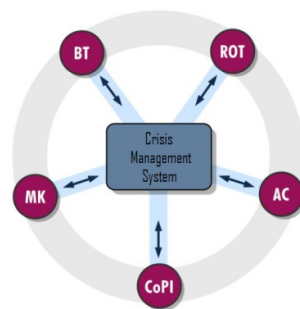


FIGURE 11: WORKING NETCENTRIC [30]

# CHAPTER 3: PAST CRISIS AND MULTIDISCIPLINARY CRISIS EXERCISES

*This chapter discusses three crises and three large scale multidisciplinary crisis exercises that occurred or where held in the Netherlands. Hereby the focus lies on the problems that exist in crisis control. These problems are recognized using the evaluation rappsorts written afterwards. The goal of this chapter is to find problems that seem to occur regularly and are problems this thesis tries to help solve. The disasters discussed are: the firework disaster in Enschede, the Chemie-pack fire in Moerdijk, and the bar fire in het Hemeltje in Volendam. The sequence in which the disasters are discussed are not chronological, but based on impact and GRIP level. The Exercises discussed are: Bonfire in 2005, Voyager in 2007, and Waterproef in 2008.*

## 3.1 FIREWORKS DISASTER ENSCHEDE

On 13 may 2000 a large explosion took place at the firework factory S.E. Fireworks in Enschede the Netherlands. The disaster killed 22 people, four of them fire-fighters, and 950 people got injured [32]. The fireworks-disaster was a disaster of exceptional magnitude for the Netherlands. This section discusses the disaster and examines the way the disaster was controlled. The focus lies on the managerial aspects of the disaster control. The problems that occurred on the higher managerial level, for example the mayor, are examined using evaluation



FIGURE 12: IMPRESSION OF THE FIREWORK DISASTER ENSCHEDE

rappsorts made in the period after the disaster.

### 3.1.1 RISK CONTROL

After the firework disaster the committee Oosting was established to research the firework disaster. Their final rappsort describes, analyses and judges the happenings and actions taken before during and after the disaster. Oosting concludes that both the municipality of Enschede and S.E. Fireworks did not live up to their responsibilities. Both parties did not adequately handle the permit application process. S.E. Fireworks did not request all the necessary permits, not in time or not at all. In turn the monitoring of S.E. Fireworks by the municipality was inadequate. Oosting concludes that if the adequate regulations were in place the initial fire started at S.E. Fireworks may not have had such a catastrophic outcome [32]. The third party, the government, also did not adequately fulfill their role as advisor, licensing authority and regulator. These shortcomings are evidenced by the fact that for a long time there were no clear legislations for operating professional firework [32].

### 3.1.2 CRISIS CONTROL

In Enschede there were already several plans and other documentation containing organization structures, instructions and policy plans regarding different kinds of disaster scenarios. The control of a disaster like the firework disaster was in 2000 the responsibility of several organizations: the municipality Enschede, region police Twente, municipally fire station Enschede, regional fire station Twente, and the medical assistance organization region Twente (GHOR) [32]. However, during the firework disaster, the activities and actions described in the plans did not happen accordingly.

#### Responsibilities

The plans available in Enschede for disaster control dictate that when a local disaster occurs the mayor is in command. However when there are parties involved from outside the municipalities, there is no clear command structure. During the firework disaster this resulted in an unclear situation between the municipality and the regional coordination center [32]. Even though there was no plan that provided a clear hierarchy, the problem could have been identified before a disaster had taken place by training of the managerial level. Especially training of a level higher than the mayor would have exposed the missing hierarchical structure that is to be followed during a crisis that involves multiple municipalities. This aspect was recognized by the committee Oosting, which states that crisis control starts with a good preparation. The committee Oosting states that the importance of training is also to let those people that are supposed to work together closely during a crisis get familiar with each other.

#### Coordination and collaboration

Another point of friction between the plans and actual actions taken is regarding the coordination and collaboration. The collaboration between the municipal disaster staff and the emergency services was not clear for all people involved. Furthermore there was uncertainty about the communication relationships between the local and regional coordination structure, as well as uncertainty about the type of task of some municipally sections [32].

Uncertainty also existed due to the fact that in the first hours of the fire, there were two operating COPI's, where the plans dictate there should be only one. The plans also dictate the degree of operational leadership expected from the COPI. However the first hours of the fire it was unclear if and how much operational leadership should come from the COPI regarding the disaster control [32].

A last coordination mishap mentioned by the committee Oosting are several processes in the control room. There were too many calls and too many requests for information coming in for the control room to handle, which resulted in a failing of the scaling process. Because of this some disaster controlling officers were not alarmed in time by the control room [32].

#### Information provision

The information provision was another point of friction. For (managerial) functions during the controlling of a disaster, it is from critical importance to be able to have the most accurate and up to date information as possible. To ensure such an information flow, it is necessary to have a well-functioning technical infrastructure. During the firework disaster, however, it became apparent that the information connections were failing in the first

most crucial and hectic hours of the disaster. Especially the municipal staff had great trouble creating a clear view of the situation at hand due to failing information connections. Also, the national emergency infrastructure failed to present itself as a suitable solution [32].

The poor information provision brought uncertainties, at the disaster site as well as with the municipal staff, about possible explosions at a nearby brewery, and the possibility of asbestos existence [32].

During a disaster, the city council has a special task in the controlling of that disaster. The responsibility causes a feeling of great pressure for the mayor and his staff. They are held accountable by their fellow citizens, even though during the first days their information source is limited and, just as most citizens, they were depended on the different news media [32].

Berghuijs et al. [33] in general supports the findings of the above mentioned statements by the Oosting committee. Regarding the functioning of the management team and policy team, Berghuijs et al. states that it is highly recommended to create a pre-determined structure for the disaster control staff with regular practice of that structure and composition. It is emphasized that there is a need for a script with emergency regulations including some sorts of models to clarify processes and protocols for the managerial disaster staff [33].

### 3.1.3 CONCLUSIONS

During the Enschede firework disaster, not all predetermined working methods were followed and some of those methods were not clear. Table 9 shows these problems divided in 3 main problem areas: communication, compliance, task recognition.

Firework disaster Enschede	
Keyword	Points of neglect
<b>Compliance</b>	There were two COPI's, while there should have been only one.
	Insufficient leadership from COPI in the first hour
<b>Communication</b>	Unclear communication paths, it is unclear for many people involved who to communicate and collaborate with.
	Failing information connections, resulting in an incomplete overall picture of the disaster.
<b>Task recognition</b>	No clear command structure, when multiple municipalities are involved.
	Unclear roles and tasks for the people involved at a managerial level.
	Often unclear who is in charge.

TABLE 9: CONCLUSION FIREWORK DISASTER ENSCHEDE REVIEW

Table 9 shows various problems that occurred before or during the firework disaster. Some of these problems are faults made by the municipality Enschede or S.E Fireworks in terms disobedience of the rules and legislation, or lack in acquiring the necessary permits and the monitoring thereof. Other problems occur at the level of the control room due to

an overflow of calls coming in from civilians who want to report the highly visible fire and smoke. These problems need to be examined and prevented in the future.

The problems that occur on a managerial level at the time of the fire however, are mainly problems in terms of an unclear or insufficient hierarchical structure, a lack of knowledge of the predetermined roles and insufficient training of the managerial level. The demand for a clear structure can be derived from these problems and are recognized by the committee Oosting and committee Berghuijs. The recommendations, done by these committees, highlight the need for a more structured way of crisis control. Models can help bring this structure, help clarify the roles and tasks, and help the development of training programs which ultimately might help to improve the quality and repetition of the training. The division of the Netherlands into safety regions and the introduction of the GRIP levels already helped to bring some clarity, however the next section, which discusses the Chemie-Pack disaster shows that these measures did not (yet) have the desired effect.

## 3.2 CHEMIE-PACK

On the 5th of January 2011 there was a great fire at the chemical plant “Chemie-Pack” in Moerdijk. Chemie-Pack is a chemical company that fills and makes chemical packaging. The cause of the disaster was an open fire that was used, contrary to the permits, by employees of Chemie-Pack [34]. Because of the large amount of chemicals present at the plant, the fire escalated and expanded to an exceptionally large fire [35]. The toxic cloud that resulted from the fire classified this as dangerous, involving various safety regions [36]. Resulting research about the disaster, just like the firework disaster, is done by several research bodies. This section discusses the findings of these reports mainly focusing on the administrative functions.



FIGURE 13: IMPRESSION OF THE CHEMIE-PACK FIRE

### 3.2.1 RISK CONTROL

The underlying causes of the disaster as stated by the “research body for safety” (OVV) are the lack of compliance of the permits, own policies, and procedure. On the day of the fire, Chemie-Pack did not follow the pre-determined way of working in the permits and did not take any of the safety measures to control the fire. Furthermore, the staff working at the moment of the fire was not instructed on how to handle such serious occurrence and therefore did not stop the pump at the chemical plant which would have resulted in the prevention of the fire [35]. Finally the risk management was not on the technical and organization level that it is supposed to be. For these reasons, the fire emerged as it did and as such, the cause of the disaster lies for the most part with Chemie-Pack itself [35].

Despite the fact that the municipality of Moerdijk noted on several occasions that there were shortcomings in the requests and compliance of permits by Chemie-Pack, they neglected to check up on the chemical plant more firmly and with greater regularity [35]. Further research showed that violations of the rules and permits were at order at Chemie-Pack. However a lack of safety precautions, pattern of repetition, and violations of the regulations by Chemie-Pack were not seen by the government as a lack of safety awareness. Also, the inspections were all announced in advance, which caused the

inspections not to find the violations they should have if the inspections were unannounced. The OVV therefore concluded that the government was too slow and too accommodating in the handling of the violations occurring at Chemie-Pack [35].

### 3.2.2 CRISIS CONTROL

The effect of the fire at the chemical plant expanded over time to other regions, making this accident an above regional disaster. There were two safety regions involved and several municipalities as well as many national government parties [35]. Several problems were recognized during the attempts to control the fire, especially in terms of communication.

The GRIP scaling mechanism as introduced in 2006 was used to classify the fire at Chemie-Pack. Even though there are straightforward guidelines on how and when to scale a disaster, the scaling was one of the problems recognized during this disaster [37]. It was unclear who should initiate the scaling to GRIP 3. There was a lot of discussion about the right level of scaling, the mayors of the different municipalities often disagreed [36]. As a result nobody scaled higher than GRIP 2, even though the crisis plans dictated that in this case it should have been done.

During the disaster the LCMS system was used to create a uniform picture. The ROT team used it to share information with all other teams and regions. However, not all regions were familiar with the system and not all officers were familiar with the way that they required access permission for the LCMS system. This resulted in an incomplete picture of the disaster and a deficient information distribution. Also, the fact that the GBT worked with logs instead of the agreed minutes and decision lists resulted in a GBT team that worked in an uncoordinated manner.

Table 10 gives an overview of problems during the Chemie-Pack fire.

### 3.2.3 CONCLUSIONS

The disaster at Chemie-Pack is a good example of problems that have not yet been addressed in current crisis control plans. Most of these problems are regarding communication, role-uncertainty of own roles, insufficient knowledge of each other's roles, and lack in knowledge of predetermined protocols and rules. Both the "research body for safety" as "the public order and safety inspectorate" recognize the insufficient knowledge in task, roles and collaboration agreements of the people management involved in crisis control. They emphasize the necessity for more multidisciplinary training.



Chemie-Pack Moerdijk	
Keywords	Points of neglect
<b>Communication</b>	No collaboration on how to communicate to the citizens
	Difficulty in comprehension and in time communication between parties involved due to lack of knowledge of each other's tasks and responsibilities in the new safety regions law and due to the switching of roles during the disaster.
	Poor accessibility of the municipally of Moerdijk and 2 involved safety regions due to unawareness of the impact of the fire which resulted in a poor and slow scaling process of the disaster.
<b>Compliance</b>	Bad communication to the citizens due to the lack of knowledge of measuring data gained from "Milieu Accidents Service"
	Lack in the law safety regions which do not consider the managerial alignment in case of an above region disaster when there is not a national crisis.
<b>Task recognition</b>	Problems with GRIP-scaling, not correctly scaled, uncertainty about who should initiate further scaling after GRIP 2.
	Each others tasks and responsibilities are unclear.
<b>Coordination</b>	Too much switching in roles of the parties involved.
	Uncertainty of the national role of parties like the NCC, ICCB, and V&J. The role of these parties often changed.
	Uncertainty about the role of the 'managerial support team environmental accidents', this despite the collaboration agreement. This can be explained due to the above regional nature of the disaster which resulted in the uncertainty about who had responsibility.

TABLE 10: CONCLUSION DISASTER CHEMIE-PACK MOERDIJK REVIEW

### 3.3 VOLENDAM NEW-YEAR BAR FIRE

New-year evening of 2000 to 2001 a fire started in the bar “het Hemeltje” in Volendam. This fire rapidly expanded and became a disaster with great consequences. The fire resulted in the death of thirteen young adults and severely injured two hundred, many of those injured still suffering from the injury they sustained.

The cause of the accident was (light) firework which was held up in the air at the bar setting the very dry Christmas decoration, which was attached to the ceiling, on fire. The reason for the fire to expand rapidly was that the decoration was not properly treated to be fire resistant. The emergency exits did not offer the possibility for a rapid and safe exit like they should have. The fire extinguishers and other prevention methods which are mandatory by law were not adequately available [34]. For these reason the fire had a horrifying outcome.

According to the committee charged with the research of the disaster, many mistakes were made in the disaster control, like poor preparation, poor proficiency of the parties involved, considerable delay in the scaling of the disaster, working mono-disciplinary instead of multidisciplinary, poor alignment, no clear one headed command at the disaster site, poor communication, and problems due to independent separate control rooms for all the different departments [34].

### 3.4 LARGE DISASTER EXERCISES

At an operational level, there are many exercises done to keep the quality of various public services at a high level. The fire department, police department and medical personnel undergo several training a year. To train for crises where the managerial levels are also involved and all public services need to work together, a large scale training is organized at least once every three years [38]. These multidisciplinary exercises are evaluated afterwards and form input for changes in laws, communication methods, organizational structures etcetera. The problems that occurred during some of these large training sessions at a managerial level are discussed in this section.

#### 3.4.1 BONFIRE 2005

On 6 April 2005 the crisis-control-exercise Bonfire took place at various locations in the Netherlands. The theme of the exercise was a terrorist attack; first a terrorist treat, second a terrorist attack in the Amsterdam Arena, and third a hostage situation. Bonfire was a unique exercise in size and in realism [39].

Goal of the exercise was [39]:

*Practice the decision making process in the full operational and managerial hierarchical structure (from the CoPI through the RBT to the Ministerial policy team) during a terrorist attack.*

In the observation rapport for the Bonfire exercise four crisis control subjects are considered. This part bases on those subjects when giving the problems encountered during the exercise: coordination, central vs. decentralized decision-making, internal information provision, and communication.

### Coordination regarding national level

- Regarding the GRIP scaling, this was initially, during the terrorist treat, done correctly. After the explosion in the Amsterdam Arena however, the scaling was based on information obtained through the media instead of the predetermined scaling structures.
- The fact that Bonfire was a terrorist oriented training caused confusion on the decision structure that needed to be followed, as there were different mechanisms and structures for 'regular' crisis and terrorist threats. It was unclear, for example, which departments should be involved in the decision making process. This confusion resulted in unmade decisions and a lack of communication regarding measures for the seaports in the Netherlands.
- There is high pressure on the leaders of the MBT. This because of the wide task perception, which resulted on a focus mainly on the most necessary actions instead of long term decisions. Also, the NCC was not able to fulfill their informative role directed to the MBT.

### Coordination regarding managerial level

- There is limited direct contact between the key officials of the MBT and the municipal staff regarding coordination of the activities on national and municipal level.

### Central vs. decentralized decision making

- Because of the centralized national end responsibility for the use of the unit intervention marines meant that the decision making process took longer than desirable.

### Information management

- The provision of analyzed, integrated information for the IBT and MBT was not consistent, and did not include the necessary tailored advice. Also, the information was not actively sought, which made that the information arrived at the decision makers to late. These aspects made that the decisions, which needed to be made where based on raw information and where out of context. The latter also made that the NCC, responsible for executing the decisions, was not able to perform its tasks.
- Information exchange between the different departments and the BZK was limited.
- In the early phases of the exercise the information available on a national level, reached the regional and local level delayed and fragmented.
- The information exchange between the national and local level did not function as it was determined in the crisis plans.

### Communication

- Alignment of the external communication by the national level with the external communication of Rotterdam and Amsterdam was sought, but only found scarcely.

### 3.4.2 VOYAGER 2007

Voyager was a large-scale and multidisciplinary crisis decision-making exercise, which was held in October 2007. The exercise covered all levels, from the operational to the highest managerial level. Voyager was the follow-up to the Bonfire exercise. The crisis control subjects that were important in this exercise are information management, decision-making, and communication towards media and the public. The theme of the exercise was a disaster involving chemicals, large-scale action, many victims, and a terrorist treat [40].

Goal of the exercise, roughly translated [40]:

*Practice the crisis decision-making process and the interaction between parties of all managerial departments from the highest level to the operational level.*

The most important conclusions drawn from the exercise according to the evaluation rapport done by Capgemini, TNO and Berenschot are listed below. The listing is based on the three key elements: information management, decision-making, and communication towards the media and the public.

#### Information management

- The degree in which all relevant actors had a shared image of the different events during the exercise can be improved.
- The different levels of crisis control did not have a unified image of the different threats and incidents with their cohesion and action that could be taking.
- The cause for the two points mentioned above is that the information exchange does insufficiently take place and not in time. As a result not all managerial levels had the minimal amount of information necessary to function and make decisions as they should have.
- Lack of interoperability made that the information and communication sources used did not work well when sharing the information uniformly between the multidisciplinary actors. The causes for this are the inter-organizational barriers (like different ICT policies).

#### Decision-making

- It seems like the managerial officers are unaware what the effects of their decisions are and if those decisions achieve the indented operational outcomes.
- Alignment between departments on a national level should be improved. Decisions were not formulated in a clear and structured way. This influenced the way other organization coped with the decisions.
- Responsibilities of a department are known within that department, however the responsibilities of the other departments are not always known. This is mainly because of missing scaling criteria to a national level and the responsibilities involved in this scaling.

## Communication

- The speed at which information is addressed to the media and public needs to be evaluated.

Conclusions that were drawn by the evaluation rapport [R9] included several recommendations based on the Voyager exercise. Several important recommendations for improvement are:

- Gain more insight in responsibilities of other actors during a crisis.
- Train more often the collaboration between:
  - All managerial levels
  - Private and public sector

The last recommendation of the two should focus on the operational effects of managerial decisions.

### 3.4.3 WATERPROEF 2008

The Waterproof exercise took place in almost all safety regions across the Netherlands. The exercise included multiple scenario's surrounding the subject of water; coastal-, river-, and lake-scenarios. The fact that this exercise took place over five days strengthened the learning efficiency.

The overall goal of the organized exercise Waterproof is [41]:

*Be organizationally better prepared for floods by the end of 2008, with a focus on limiting human suffering and social disruption.*

The various scenarios in Waterproof are designed to test the crisis plans and complement them is necessary. The recommendations done in the final evaluation rapport [41] are therefore not all suitable as recognized problems for this thesis, the few recommendations that are suitable are listed below.

- Managerial officers should keep the urgency of the organizational preparation for floods high by keeping plans up to date and as complete as possible, keep their experience and expertise (education and training), and, most importantly, by practicing with exercises.
- Make a clear distinction between the actual situations and expected situation.

### 3.4.4 CONCLUSION

During the three large-scale disaster exercises, several problems were recognized that were also found during the real disasters described in this chapter. The main returning issue is information management and communication. It is hard for the many disciplines involved to share a constant uniform picture of the disaster. This is also because of the non-optimal communication between the different disciplines and hierarchical levels. The reason for this is that information is often not pushed, but shared on demand, where often the demand of certain critical information is neglected. The latter is partly caused by lack

of knowledge of the various disciplines present. For example during the Voyager training, an external party, ExxonMobil, which had critical information regarding the crisis, was not seen as a partner and was insufficiently involved in the information exchange.

The three disaster exercises show that even though various plans have been developed over the years, there is room for improvement. Some of these improvements might be achieved by changes in rules and legislation, or the introduction of new (ICT related) systems. However it becomes evident that more training, especially for the managerial level, would heighten the knowledge of own roles, other roles, and rules and legislation. Besides more training a clear structured way of presenting the roles with their tasks would also help give more insight. Finally a more structured way is required to be able to check the knowledge and competences of an actor, the competences necessary for a role and the training, to be followed.

### 3.5 CONCLUSION

The disasters and exercises discussed in this chapter show that there are clear problems in crisis management. The rules and legislation that are in place often change or get fine-tuned, most of the time for the better. Although good laws, legislations, safety chains, and GRIP scaling measures help to prevent crisis from occurring and help during crisis control, it does not guarantee the prevention of a crisis from occurring and it does not guarantee a smooth crisis control organization. Of course, guarantees can never be given regarding crisis, there are always too many unknown variables, but making plans and calculations of risks are only a first step in crisis management.

The problems recognized in this chapter regarding crisis control are sometimes caused by bad luck, failing equipment, or insufficient laws and safety measures. But most of the time other aspects are the cause for the problems that occur, like insufficient knowledge from actors on managerial levels, unclear communication paths, or officials being unaware of all the roles involved. Many of these problems can be assigned to a lack in training at a managerial level. However uncertainty of the tasks of a role and the other roles involved makes that more training alone is not enough. It is often hard to recognize which training is required for an actor to be able to fulfill a certain role (which competence does an actor need to train?) and the roles and tasks are described in stacks of documents. This shows that there is a need for a way to structure the necessary information. For a summary of the problem recognized during the large scale disasters, see Appendix B.

The three problems that are most recognized and were models should give more clarity are described in table 11. The modeling efforts are focused on these problems.

Main Views for Models	
Role and Task recognition view	It becomes clear that many of the managerial officials do not know all of their task and responsibilities that they are required to do by law during a crisis. It further becomes clear that many of the managerial officials that play a role during crisis control do not recognize the other roles and parties involved and the tasks and responsibilities required to be performed by them. As a result they often do not know with who they can and often should collaborate and communicate.
Information management view	It becomes clear that many of the managerial officials do not know where to obtain the necessary information, and do not know what information is available to them. Also it seems hard to recognize the partners who have vital information.
Training view	The cause for the two above mentioned problems can for a great part be sought in the training and practice for the managerial officials, or the lack thereof. Therefore the 'need for more training' is also subject for the next chapters. Because of this, training scenario's, competences and other concepts are considered which will help decide what should be trained, which scenarios are suited for what training purpose, and will provide a measurement that can be used to decide if the different managerial officials are ready to be part of the crisis organization. Also training should for a great part solve the problems with role- and task recognition and information management.

TABLE 11: MAIN VIEWS FOR MODELS

## CHAPTER 4: MODELS

---

*The problems recognized in the previous chapter require a solution that is sought in modeling. Models are not extensively used in the public order and safety domain. An overview is given of those models used in the domain in section 4.4. The use of models in the business world however is considerably higher, especially in administrative companies like insurance companies, government agencies and banks. This section gives an overview of the current state of the art in modeling techniques that could be relevant for the public order and safety domain. This chapter starts with a general description of models in section 4.1. Section 4.1 describes Enterprise Architecture modeling and the motivation of why this could help in the public order and safety domain. Section 4.2 and 4.3 show the state of the art in modeling techniques; the sections discuss frameworks, modeling languages and modeling tools. A distinction is made between enterprise architecture modeling and business process modeling. Section 4.5 shows some of the modeling techniques that are used, or have been used, in the domain of public order and safety.*

### 4.1 MODELING THE CRISIS ORGANIZATION

Before discussing the conceptual model in this chapter, this section gives an overview of what the models should be able to represent. The definition of a conceptual model, a model and the views that are considered important in the domain of public order and safety are given. The main focus regarding the required view lies on the problems stated in the previous part: Role recognition, task recognition, information management, and need for more training. Taking these problems into consideration there is a need to create views or viewpoints addressing these subjects. Next a context scenario is given and a modeling scope is given. This is done to be able to give accurate examples and to communicate the proposed solution to experts in the domain. This will also help with validation the conceptual model, which is done in chapter 6.

#### 4.1.1 MODEL DEFINITIONS

As discussed in chapter 4, there are various types of models described in literature. The definition that is used in this context is the definition provided by Osterwalder et al. [9]:

A model is *“a simplified description and representation of a complex entity or process.”*

A view is defined as [52:99]:

*“A part of an architecture description that addresses a set of related concerns and is addressed to a set of stakeholder.”*

A view is specified by means of a *viewpoint*, which prescribes [52:99]:

*“the concepts, models, analysis techniques, and visualizations that are provided by the view.”*

Figure 14 gives an example of a view on a model. Consider a model containing various information, which is complex and when shown in total there is no clear overview. Creating a view for the yellow stakeholder, who is only interested in a specific part of the



model, ensures that only the important information of the model is presented. Therefore the view, of that stakeholder only visualizes the yellow part of the model.

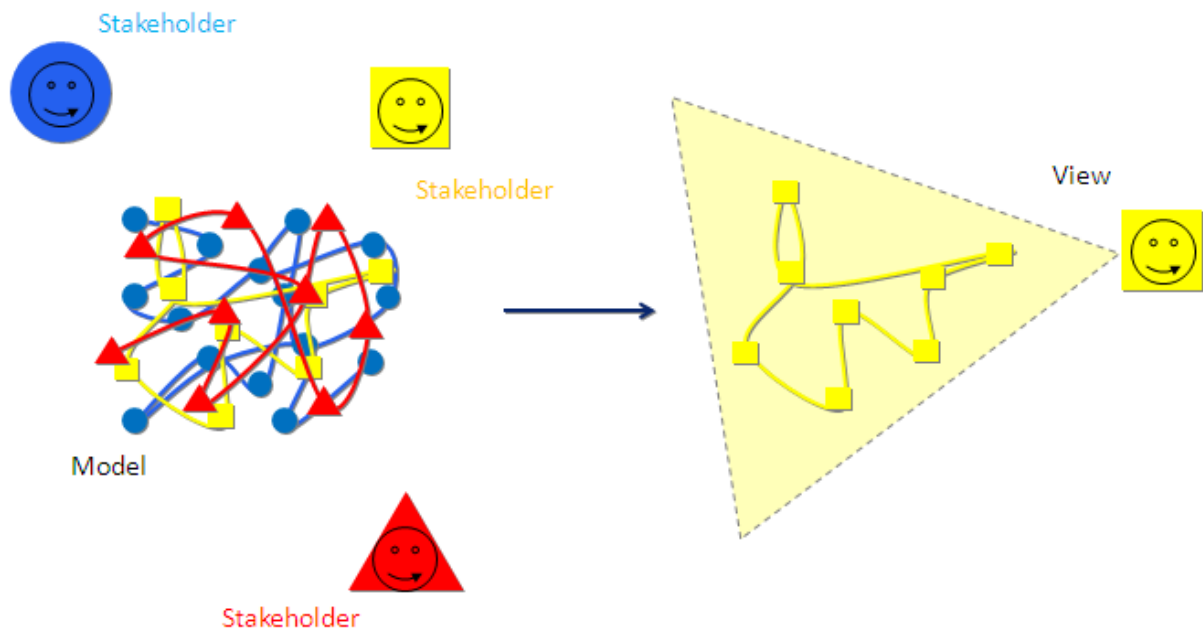


FIGURE 14: EXAMPLE OF A VIEW ON A MODEL (ABSTRACT)

## 4.2 ENTERPRISE ARCHITECTURE

### 4.2.1 GENERAL INFORMATION EA

According to Tamm, Seddon, Shanks & Reynolds [42], organizations around the world spend a considerable amount of time and effort on enterprise architectures. Academic research on enterprise architectures (EA), however, is limited and much research on EA is done by the practitioner community [42]. First let's investigate a few definitions of enterprise architectures.

According to Gartner Inc. [43]:

*“Enterprise architecture (EA) is the process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key requirements, principles and models that describe the enterprise’s future state and enable its evolution.”*

An architecture is developed to address the concerns of key people, commonly referred to as stakeholders in the system, by the business and IT systems within a organization [44].

According to Tamm et al. [42]:

*“Enterprise Architecture (EA) is the definition and representation of a high-level view of an enterprise’s business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise.”*

According to Lankhorst M. [45]:

*“Enterprise architecture: a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise’s organizational structure, business processes, information systems, and infrastructure.”*

Generally architect frameworks are used by enterprise architects to define how to organize structures and views associated with enterprise architecture. An architecture framework is described by ISO/IEC/IEEE 42010 as:

*“An architecture framework establishes a common practice for creating, interpreting, analyzing and using architecture descriptions within a particular domain of application or stakeholder community.”*

Examples of these frameworks are MODAF and TOGAF. “Frameworks structure architecture description techniques by identifying and relating different architectural viewpoints and the modeling techniques associated with them.” [45:20] According to Lankhorst et al., frameworks do not provide the concepts for the actual modeling, architecture description languages do. An Architecture Description Language (ADL) is described by the ISO/IEC/IEEE 42010 standard as:

*“An ADL is any form of expression for use in Architecture Descriptions. An ADL might include a single Model Kind, a single viewpoint or multiple viewpoints.”*

Examples of ADL’s are SysML and ArchiMate. The state of the art of architecture frameworks, ADL’s, and tools based on frameworks and ADL’s that are candidates to be used in the public order and safety domain are discussed below. First the relevance of EA is discussed and arguments are made why the public order and safety domain can benefit from EA.

### Relevance of Enterprise Architecture

A study done by Tamm et al. [42] distinguishes 4 key benefit enablers that show the advantages EA can have on a organization. These benefit enablers are listed in table 12.

Benefit enablers	
<b>Organizational Alignment</b>	The extent to which an organization’s subunits share a common understanding of its strategic goals, and contribute towards achieving these goals
<b>Information Availability</b>	The extent of useful, high-quality information accessible to organizational decision makers
<b>Resource Portfolio Optimization</b>	The extent to which an organization leverages its existing resources, invests in resources that target performance gaps, and minimizes unnecessary investments in duplicated resources
<b>Resource Complementarity</b>	The extent to which the organization’s resources synergistically support the pursuit of its strategic goals

TABLE 12: BENEFIT ENABLERS ACCORDING TO TAMM ET AL. [42]

### Organizational alignment

Tamm et al. state that besides a positive impact on business and IT alignment, EA can also have a positive impact on other dimensions of organizational alignment. The following reasons are mentioned by Tamm et al. as reasons for this broader impact on enterprises:

- The facilitation of dialogue and identification of interdependencies between the various parts of the enterprise.
- The increased understanding of the process interdependencies and potential synergies provides a better basis for potential conflicts to be identified and resolved early, which may have a positive impact on collaboration and collective decision-making.
- The relevant people can be involved early in the decision-making process, allowing for potential conflicts to be identified and resolved early, which may have a positive impact on collaboration and collective decision-making.
- The awareness that EA creates about the dependencies may also be used to ensure the alignment between performance measures of employees, which can further contribute to collaboration.

Tamm et al. mention that objective decision-making criteria are provided by a set of agreed-upon principles, which are briefly discussed below.

### Information availability

EA has the potential to improve information about processes and data about clients, suppliers and business transactions: "Through business and system analysis performed as part of the EA planning, previously undocumented information about the organization's processes may be captured (Bernard, 2005)." [42] Tamm et al. further state that even if the EA vision and roadmaps are not followed, the whole-of-enterprise analysis approach may reveal interdependencies or inefficiencies that were previously undocumented, or unknown. Further reasons derived from literature by Tamm et al. [42] are:

- It is possible that EA can improve the sharing of information through more carefully planned integration between the organization's information systems.
- EA may also facilitate information sharing by advocating common data definitions and structures.
- By identifying and helping to reduce the number of redundant data stores, EA may also have a positive impact on data accuracy.

### Resource Portfolio Optimization

Human resources, IT, and organizational processes are the three types of resources that are of primary interest regarding EA [42]. The authors recognize several reasons why EA helps to optimize resource portfolio:

- EA can help to recognize where gaps or overlaps occur and provide recommendations on how to improve that.
- By looking across verticals and horizontals of an organization, current resources overlaps will become apparent.

- EA contributes to building a more standardized IT platform with fewer technologies, leading in turn to simplified interface, higher reliability through reduced operating platform complexity, and lower maintenance and support costs.
- EA can also contribute to the identification of suboptimal business processes and use of human resources.

### Resource Complementarity

Resource complementarity is argued by Tamm et al. to be increased by EA for the same reasons discussed for resource portfolio optimization. However, resource complementarity focuses more on leveraging synergies between the resources and combining them for an enhanced performance.

### Relevance of Enterprise Architecture regarding the public order and safety domain

The public order and safety domain can be seen as a large complex organization with various departments, which just as other companies need alignment and works with various types of information.

The advantages EA has on organizational alignment makes that the involvement of relevant people of the crisis organization is stimulated, which positively affects the knowledge of the presence of other roles and other partners. The information availability benefits may help to communicate between regions, and make that there is more uniformity about the interpretation of the laws. This might also prevent the existence of contradictions in documents that currently seem to exist.

## 4.2 STATE OF THE ART IN EA

### Zachman Framework for Enterprise Architecture

The Zachman Framework for Enterprise Architecture was introduced in 1987 by John Zachman, who is considered to be a pioneer in the field of Enterprise Architecture [46]. The reasoning behind the use of architecture for Zachman is that the complexity of information system and the scope of design and levels are forcing the use of logical structures [47]. The Framework uses common vocabulary and set of perspectives to describe complex enterprise systems. It has six perspectives or views [47]: Planner, Owner, Designer, Builder, Subcontractor, and User. It shows these views versus six basic questions [46]: What, how, where, who, when, and why. The Zachman Framework is not a standard and therefore has no explicit compliance rules. Also the framework does not consider sequence, process or implementation but focuses on providing a complete system by ensuring that all views are well established [47].

### TOGAF

The Open Group Architecture Framework (TOGAF) is a framework for enterprise architecture. The first version of TOGAF was released in 1995. It was developed by members of The Open Group and was based on the Technical Architecture Framework for Information Management (TAFIM), developed by the US Department of Defense (DoD) [48].

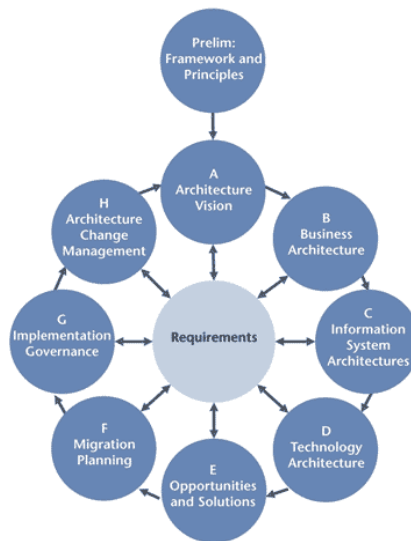


FIGURE 15: TOGAF ARCHITECTURE DEVELOPMENT METHOD [49]

TOGAF's Architecture Content Framework provides a detailed model of architectural work products, including deliverables, artifacts within deliverables and the architecture building blocks that deliverables represent [50]. The framework includes an description of a meta-model of possible building blocks, but as said it does not define a complete language. It does not provide representation for the different building blocks. Therefore it is not directly suitable for the creation of models, but provides in a useful inventory of relevant concepts and may be used to identify gaps enterprise architecture modeling languages such as ArchiMate which is discussed later in this section. TOGAF is designed to support four domains of architecture [50]:

- Business Architecture: defines business strategy, governance, organization, and key business processes.
- Data Architecture: describes the structure of an organization’s logical and physical data assets and data management resources.
- Application Architecture: provides a blueprint for the individual application systems to be deployed, their interactions, and their relationships to the core business processes of the organization.
- Technology Architecture: describes the logical software and hardware capabilities that are required to support the deployment of business, data, and application services. This includes IT infrastructure, middleware, networks, communications, processing, standards, etc.

At each phase within TOGAF’s Architecture Development Method (ADM), a discussion of inputs, outputs, and steps describes a number of architectural work products or artifacts, such as process and application. The TOGAF content meta-model provides guidance for organizations to provide guidance for organizations that wish to implement their architecture within an architecture tool.

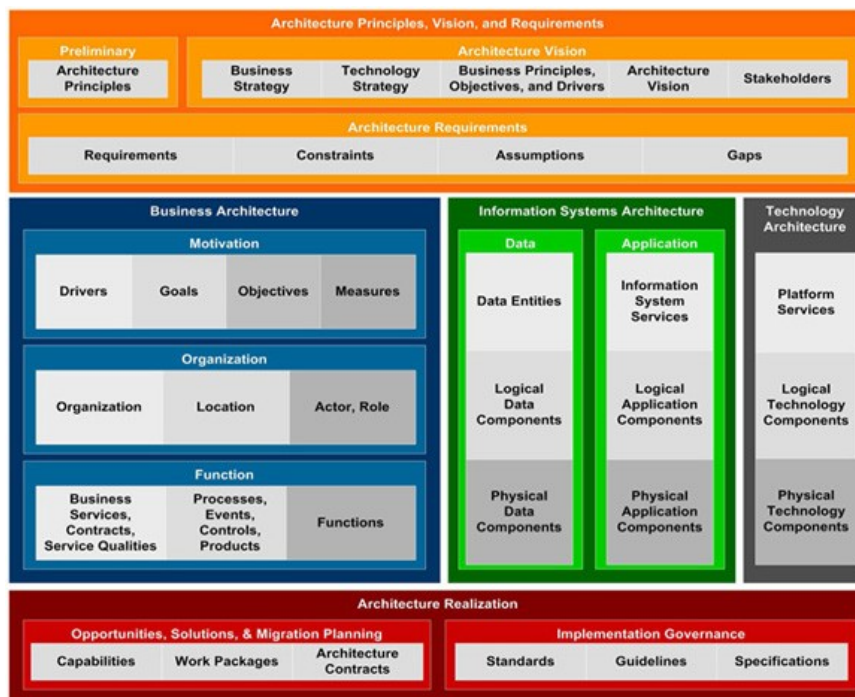


FIGURE 16: DETAILED TOGAF CONTENT META-MODEL [51]

### ArchiMate 2.0

The ArchiMate enterprise architecture modeling language has been developed to provide an uniform representation for diagrams that describe enterprise architectures [52]. ArchiMate has officially been launched as an Open Group Standard since April 2009 [53]. The ArchiMate standard is closely linked to the TOGAF standard and therefore follows the set of defined terms by TOGAF. ArchiMate is a modeling language that describes an enterprise’s architecture that involves the conceptualization of different aspects of the enterprise and at different levels of abstraction. Two dimensions are used in the language: layers, which represent successive abstraction levels at which an enterprise is modeled,

and aspects, which represents different concerns of the enterprise that need to be modeled. Figure 17 shows how the layers and aspects are used to position common architectural domains.

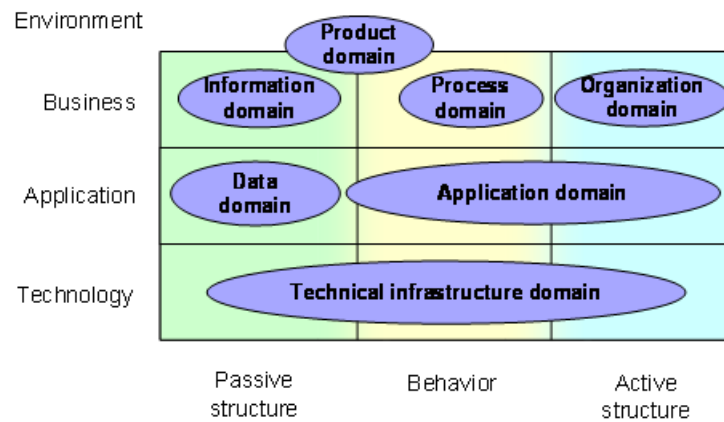


FIGURE 17: ARCHIMATE FRAMEWORK: LAYERS AND ASPECTS [54]

The layer dimension distinguishes the following three main layers [52]:

- The business layer: offers products and services to external customers that are realized in the organization by business processes
- The application layer: supports the business layer with application services that are realized by software application components
- The technology layer: offers infrastructural services (e.g., processing, storage and communication services) that are needed to run applications, and are realized by computer and communication devices and system software.

The aspect dimension distinguishes the following modeling aspects [52]:

- The active structure aspect: represents the actor (systems, components, people departments etc.) involved and how they are related
- The behavior aspect: represents the behavior (e.g., processes and services) that is performed by the actors, and the way the actors interact
- The information (or passive structure) aspect: represents the problem domain knowledge that is used by and communicated between the actors through their behavior.

ArchiMate uses standard graphical representation of the various concepts and relationships for modeling main structures within the various architectural domains and the relationship between them. Figure 18 shows these graphical representation.

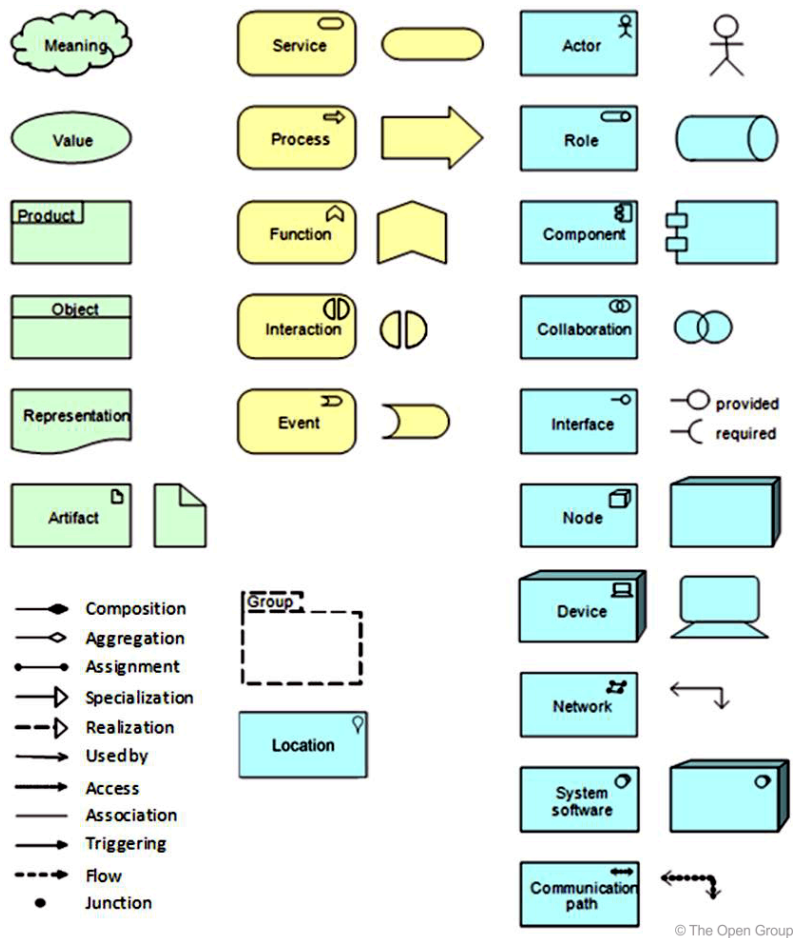


FIGURE 18: ARCHIMATE CONCEPTS AND NOTATION [54]

### MoDAF/DoDAF

The British Ministry of Defense Architecture Framework (MoDAF) and the Department of Defense Architecture Framework (DoDAF) are architectures developed by respectively the defense department of the UK and the United States. Military Architectural Frameworks such as MoDAF and DoDAF define a standard way to organize an enterprise architecture or system architecture into complementary and consistent views [56].

DoDAF was developed in 1990 and defines how to organize specifications of enterprise architectures for applications of the Department of Defense [57]. Several Frameworks like the TOGAF are derived from DoDAF. DoDAF builds on three sets of views [47]: Operational, System, and Technical Standards. Each view is suited for different stakeholders. The 'all View' provides a linkage between these views combining them by means of a dictionary which provides context, summary, or overview level information [47]. Although the framework was created for military purposes, DoDAF are commonly used by other sectors, like the private, public and voluntary sectors. The framework is used by the different sectors to model complex organizations, to improve planning, organization, procurement and management of these complex organizations [56].

MODAF defines a standard way for defense application to organize enterprise architectures [57]. MoDAF has six viewpoints, which are similar to DoDAF, to organize enterprise architecture: All viewpoint, Operational Viewpoint, Systems Viewpoint, Standard Viewpoint, and Acquisition Viewpoint. "MODAF provides a means to model,



understand, analyze and specify Capabilities, Systems, Systems of Systems and Business Processes.”[57]

## 4.4 BUSINESS PROCESS MODELING

The term business process management (BPM) entails methods, techniques, and tools to support the design, management and analyses of operational business processes [62]. These tools and techniques include modeling languages and tools, which can be used to visualize, and analyze business processes. For this reason several process modeling tools and techniques are also considered as possibilities to model the public order and safety domain. This section describes several of these tools en techniques.

### BPMN

Business Process Model and Notation (BPMN) is a standard developed by the Object Management Group (OMG) [63]. OMG is a merger between OMG and Business Process Management Initiative (BPMI). The goal of BPMN is [63]:

*“Provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes.”*

BPMN thus creates a standardized bridge for the gap between the business process design and process implementation [63]. It provides a notation that is intuitive to business users and also enables representation of complex process semantics. The specification provides a mapping between the graphics of the notation to the underlying constructs of execution languages, particularly Business Process Execution Language (BPEL). Figure 19 gives an example to illustrate the core concepts of BPMN. The example is of an incident and shows different ways of looking at a process, from a very abstract to a very detailed way. The reason for this example is to show a possible use of BPMN that, if altered, may prove to be suitable for the public order and safety domain.

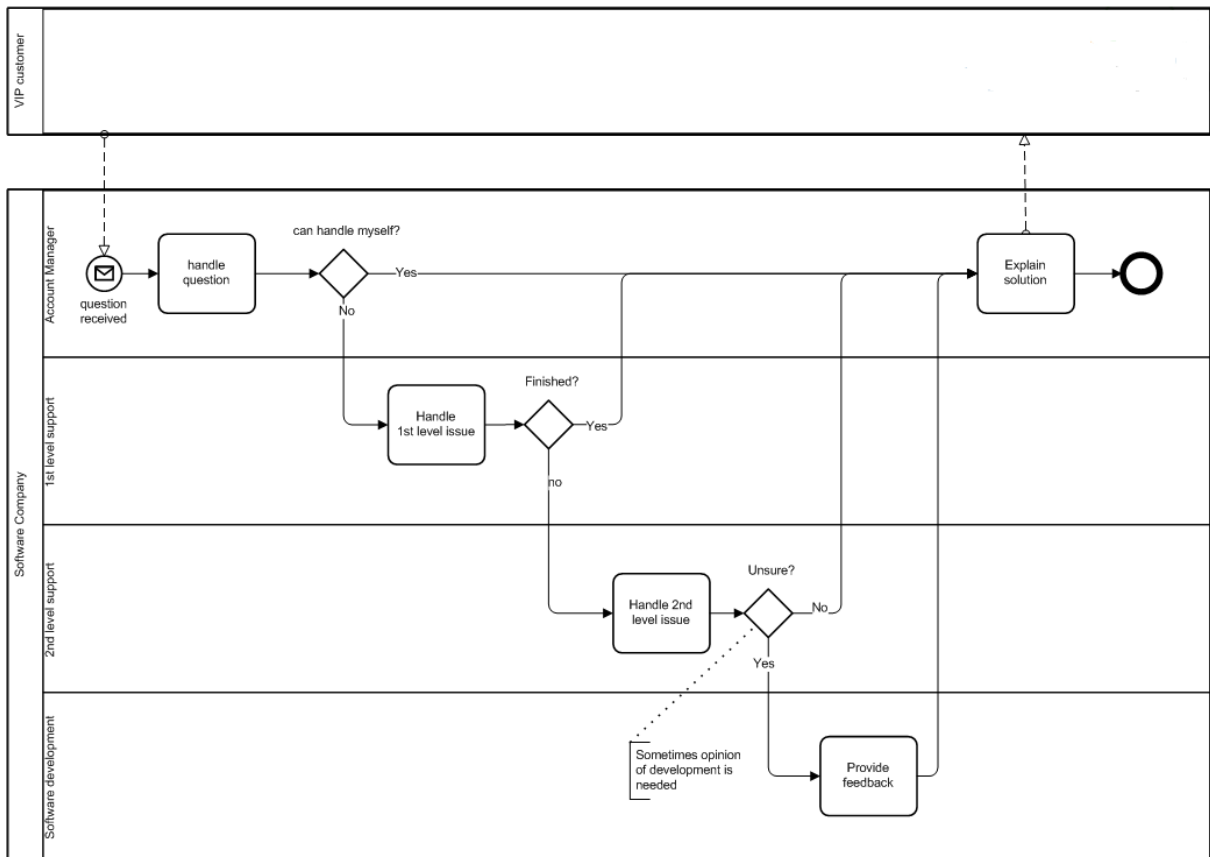


FIGURE 19: EXAMPLE OF A BPMN PROCESS MODEL [64]

Figure 20 shows an incident management process from a high level point of view. The process is triggered by a customer who requests help from the account manager. If the account manager is not able to handle the request himself, it will be handed over to the first level support agent, who will hand it over to the second level account manager if necessary. The second level account manager then figures out if the customer can fix the problem on her own, with the option to ask the software developer if he is unsure. Whichever path is followed the account manager will explain the solution to the customer in the end.

In this diagram it is assumed that there is always a solution that is communicated to the customer. Also the model lacks all details, and not all the information is available about the tasks. So this model is only suitable if you want to get a basic understanding of the process, talk about the main steps, or scope the process.

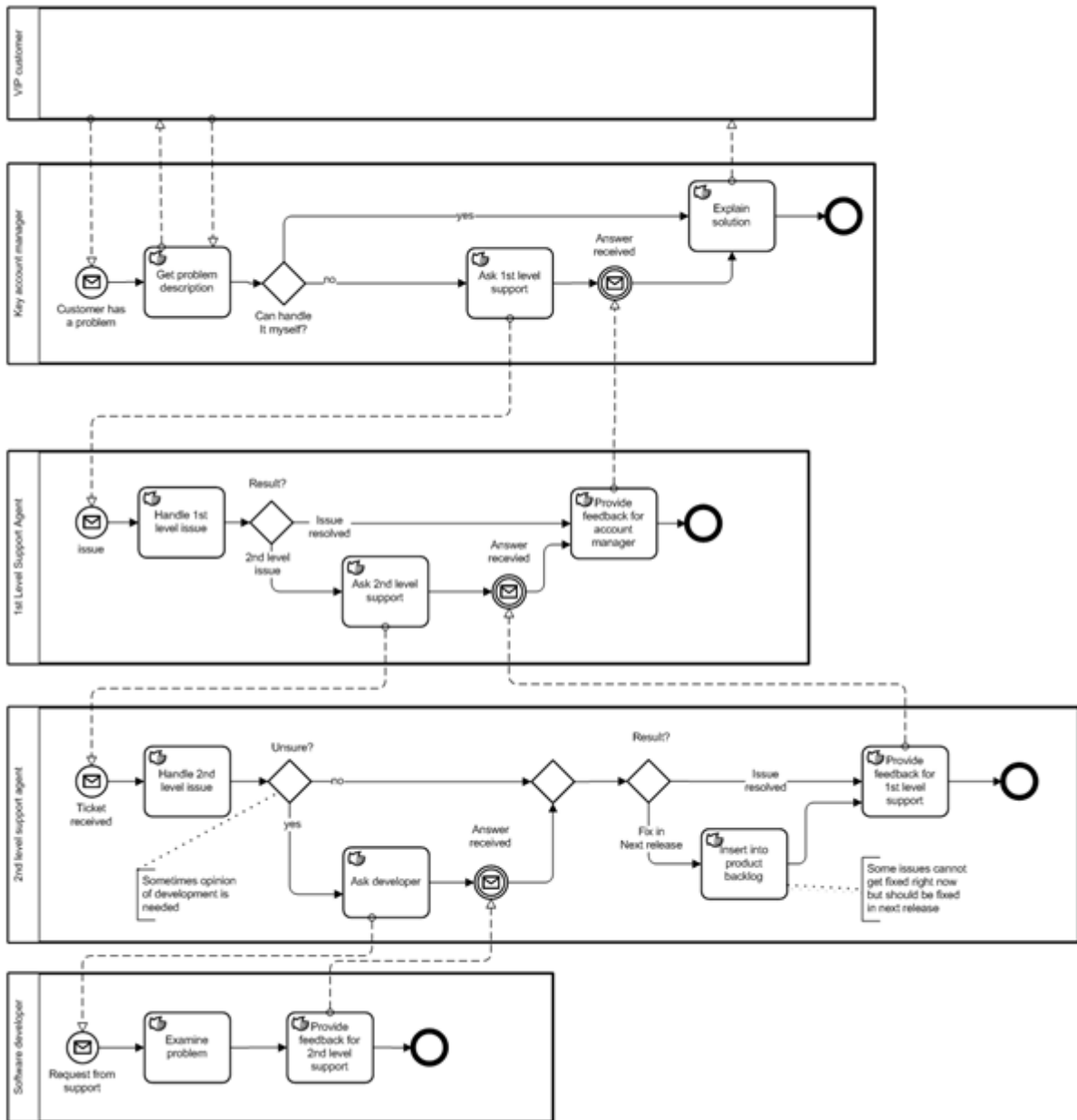


FIGURE 20: EXAMPLE OF A DETAILED BPMN MODEL [64]

In contrast to Figure 20, Figure 21 shows a more detailed collaboration diagram. Were the single-pool-model only showed this basics the collaboration diagram shows in more detail the particular processes each participant fulfills. For example, this diagram shows that the second support agent inserts the solution into the product backlog. Also, there are more details about the information flows between the managers.

The last diagram, which is shown below, is the choreography diagram and shows only the tasks that are dedicated to the communication between the different participants. Note that both Figures 20 and 21 contain the same information, but this is presented in different ways.

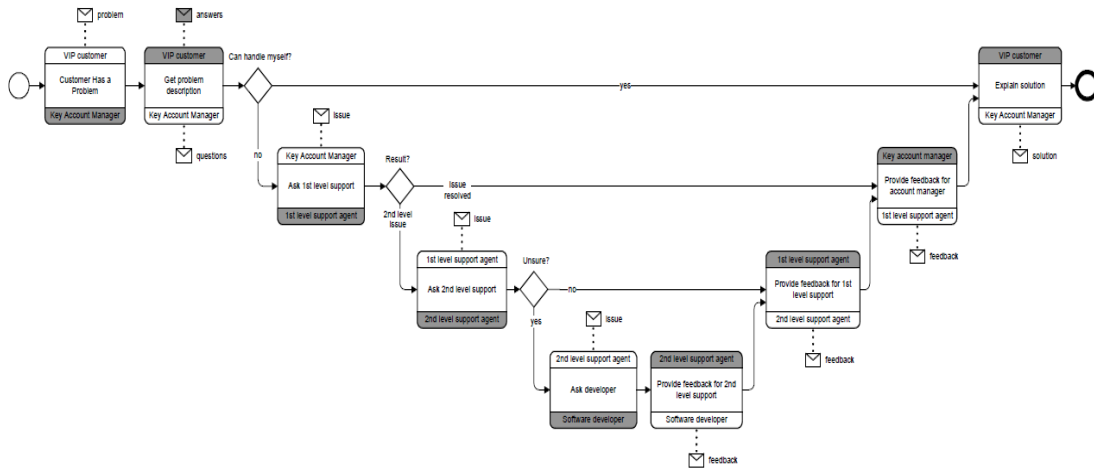


FIGURE 21: EXAMPLE OF A CHOREOGRAPHY BPMN MODEL [64]

## UML

The Unified Modeling Language (UML) is an international standard, standardized by the Object Management Group, for modeling software applications and infrastructure. UML is not only an important language for modeling software related systems, but also business processes and architecture [58]. UML encompasses many different diagram types, which are suitable for modeling different aspects of a system. The diagrams class diagram, use case diagram, activity diagram, and sequence diagram are discussed in more detail below.

### Use Case Diagram

A use case visualizes the functionality of a system. The main goal of use-case diagrams is to provide the user with a visualization of the actors, their goals, and their interaction, also between use cases. A use case diagram shows what system functions are performed for an actor to reach their goals. Figure 22 gives an example of a use case diagram.

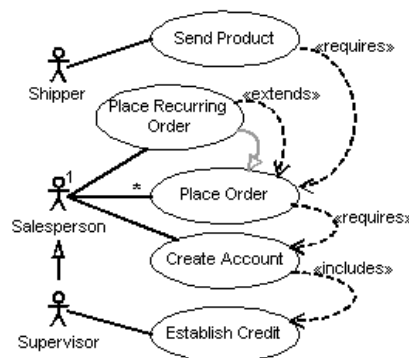


FIGURE 22: EXAMPLE USE CASE DIAGRAM [59]

### Class Diagram

A class diagram is the most used structural model of the UML. It is a two dimensional graph to model classes, attributes and the relationship between classes. Figure 23 shows a simple example of a class diagram.

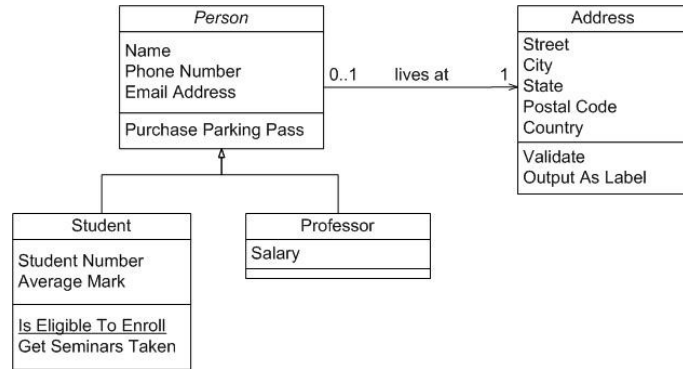


FIGURE 23: EXAMPLE CLASS DIAGRAM [59]

### Activity Diagram

An activity diagram describes the activities in a system in step-by-step business and operational workflows.

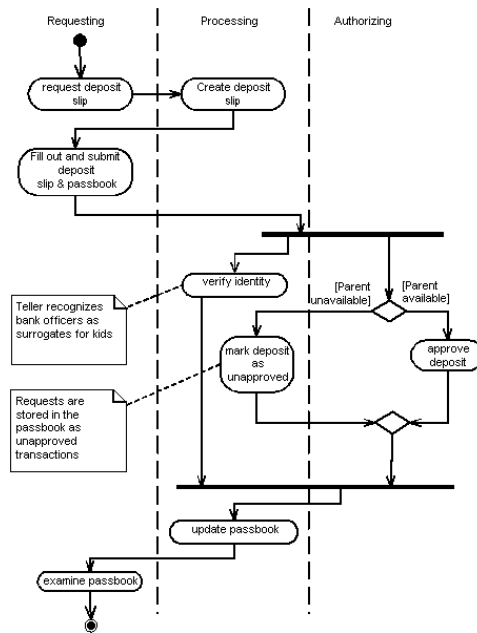


FIGURE 24: EXAMPLE ACTIVITY DIAGRAM [59]

## Sequence Diagram

A sequence diagram shows how processes operate with each other and in what order. Uses cases have parallel vertical lines, representing different processes or objects. The horizontal arrows show the message exchange between these processes or objects. Figure 25 shows an example of a UML sequence diagram.

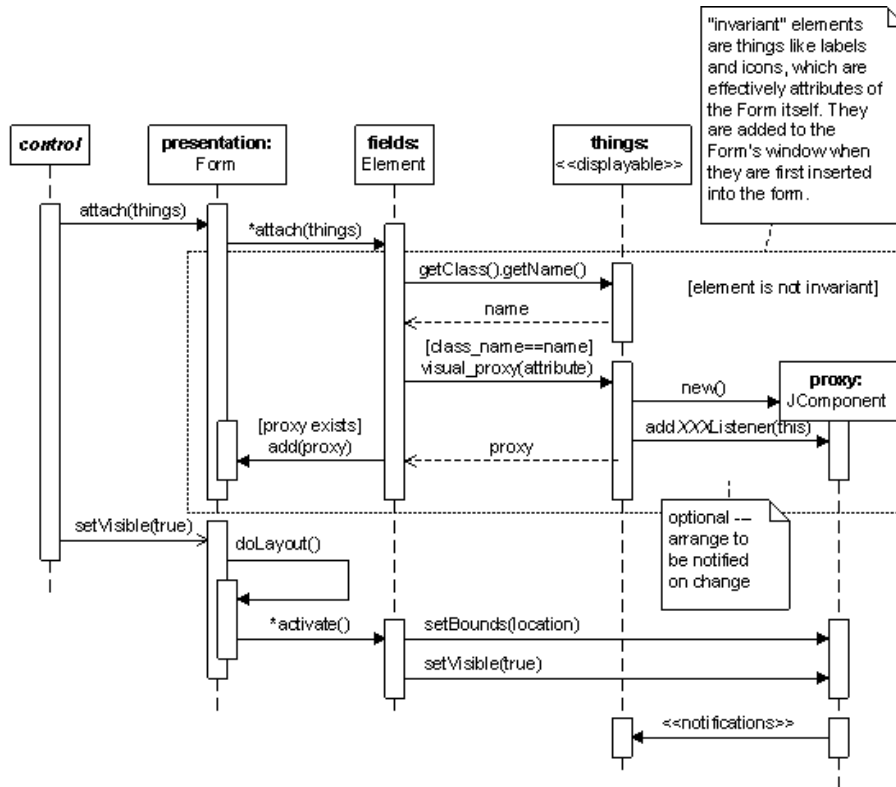


FIGURE 25: EXAMPLE SEQUENTIAL DIAGRAM [54]

## AMBER/BiZZdesigner

BiZZdesigner is a commercial tool, which offers support in design, analyses, documentation and communication of processes, organization, and information provisioning [66].

The tool provides a way to model the essence of processes, organization and information structures, in order to design and execute processes. The tool is based on the language AMBER. Figure 26 shows an example of a insurance claim process modeled with BiZZdesigner.

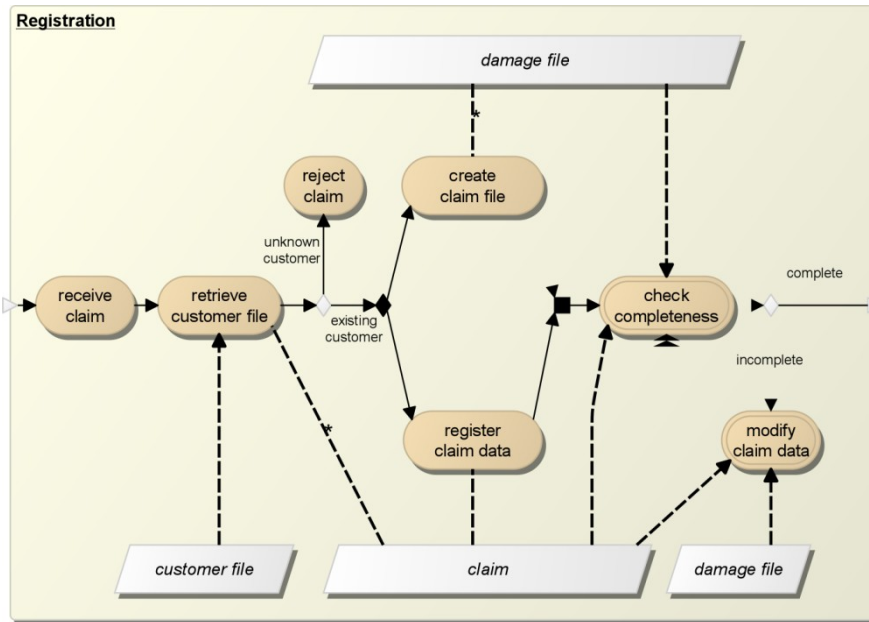


FIGURE 26: EXAMPLE OF A BIZZDESIGNER BEHAVIOR MODEL [66]

The advantage of the tool BiZZdesigner is that its user can define additional properties for modeling elements and also, change the graphical appearance of concepts. This ensures that it is possible to modify the tool for specific uses.

## 4.5 MODELS USED IN PUBLIC ORDER AND SAFETY DOMAIN

Models in this domain are often (large) documents describing plans. The domain only makes use of modeling techniques on several occasions which are discussed in this section.

### Information model public order and safety

The Informatiemodel voor de Openbare Orde en Veiligheid (Information Model for the Public Order and Safety, IMOOV) is meant to be a joint conceptual framework focused on site-specific information that you can project on a map [67]. It is meant to contribute in formulating a shared view among emergency services. The goal is defined as:

*“Purpose of the IMOOV is to bring consistency in the multitude of concepts in the public order and safety data relating to an area or specific onsite conditions.”*

The information model is used for three kinds of incidents; fire in large buildings, traffic collisions, high water. Figure 27 shows how a traffic collision is presented in the IMOOV.



FIGURE 27: EXAMPLE OF A TRAFFIC COLLISION REPRESENTED IN IMOOV MODEL [67]

### Administrative network maps

Another use of models in the public order and safety domain are the administrative network maps. The goal of these maps is to gain insight in the managerial parties that play a role in a sector during a crisis [68]. The maps try to show responsibilities of the different roles involved. Starting with an overview of all crisis types, possible measures, and authorities. The actual maps describe the different sectors involved for each of the crisis types and the communication, information, and command lines between them. The maps particularly show the collaboration between the general chain and functional chain during a crisis. Figure 28 gives an example of the administrative network map in this case the general chain and the chain 'water management'.



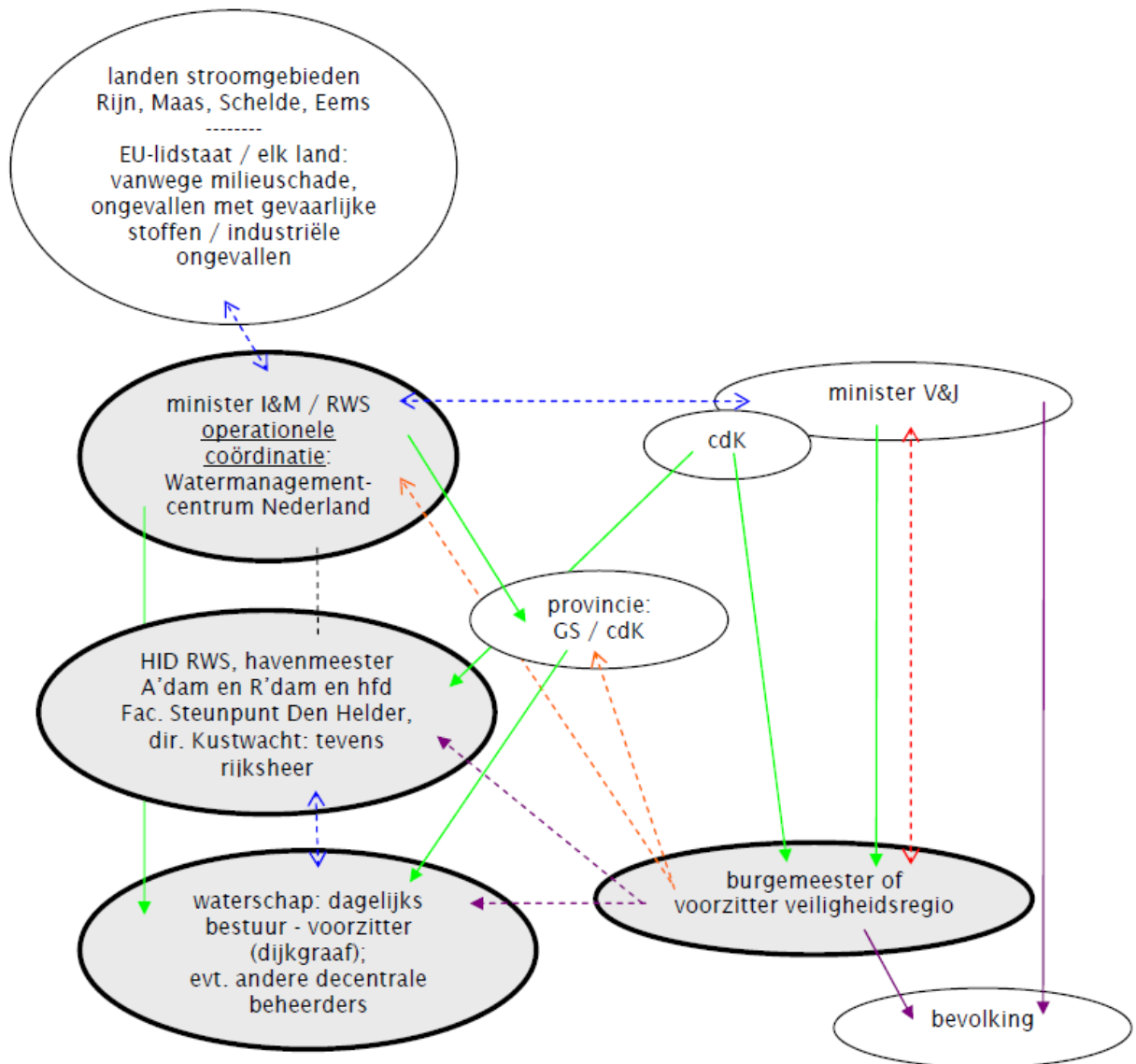


FIGURE 28:EXAMPLE OF AN ADMINISTRATIVE NETWORK MAP MODEL (DUTCH) [68]

### Bizzdesigner's Architect used in the domain

A final modeling application used in the domain is Architect. The models map the operation level of crisis control [69]. The created models were part of a project called information management for the safety sector, which had as goal [70]:

*"[...] the realization of an unambiguous framework for the exchange of information in disasters and crisis."*

The model that was the result of the project shows crisis control processes that are linked to different public services, e.g. the police department. In more detail it shows which process steps, and the actors related to those steps, are required to fulfill a certain general process. Figure 29 shows an example of evacuation during a disaster. The first picture on the left shows the sub steps that are followed during an evacuation. The second picture shows in more detail who are involved during one of the sub processes of evacuation, namely preparation of evacuation, and the more detailed process steps.

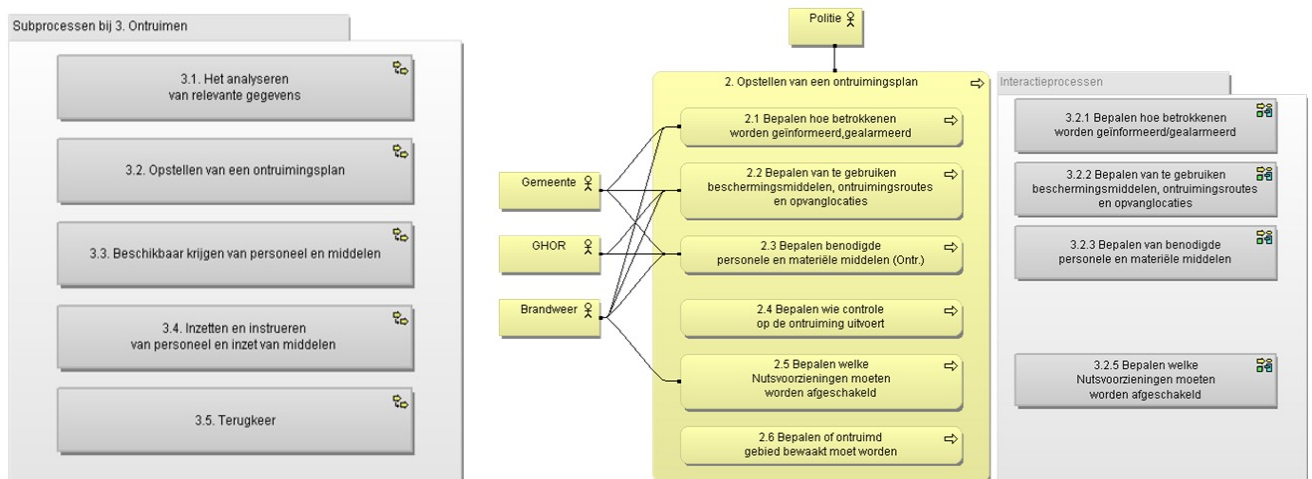


FIGURE 29: EXAMPLE OF ARCHITECT USED IN THE PUBLIC ORDER AND SAFETY DOMAIN, FROM [70]

However, there seems to be a lot of detail in the model and the model is extensive for the operational level; there is no record of them being used in the domain of public order and safety.

The three models mentioned above are examples of the very limited use of models in the domain. The extent to which these models are used is questionable, however the network maps are thought of as important for various safety regions, which is shown by the fact that they are updated yearly. Also there is a lack of proper use of modern modeling techniques and tools that are currently available.

## 4.6 CONCLUSION

The modeling techniques described in this section have given an indication of possibilities of techniques and tools that have been used and are used for enterprise architecture and business process modeling. Although a few attempts have been made to use models in the domain, the usage and implementation is limited. The selection of a modeling technique that is suited to use for providing models for the public order and safety domain is done in the next chapter.



## CHAPTER 5: REQUIREMENTS FOR A CONCEPTUAL MODEL

---

*In this chapter requirements are formulated as criteria for selecting a modeling technique and to determine the concepts and relationships needed to design a new modeling language and a conceptual model. The conceptual model is created to research the possibilities of using models in the public order and safety domain. Since the newly defined language is developed to model a domain where modeling techniques have not been used, the new language will be called the Public Order and Safety Modeling Language (POSML).*

*Requirements can be defined as the capabilities of what somebody wants or needs [71]. Robertson [71] distinguishes two kinds of requirements, the conscious requirement and the undreamed requirement. The conscious requirement is a requirement that a stakeholder is most likely to know and communicate. Undreamed requirements are requirements that are often not mentioned by stakeholders because they often think those requirements will not be possible, not fit in a budget, or simply not occur to the stakeholder. Robertson [71] in her paper provides several techniques for discovering the requirements for a system. Even though Robertson recognizes that interviews are the most traditional and the most useful technique, it may not be applicable in all situations and may not uncover all requirements. In this case it will not be possible to held interview before hand due to limited time and limited availability of stakeholders to interview. Therefore another way of requirements discovering is used.*

*The main method used to elicit the requirements for the conceptual model is through brainstorm sessions. The purpose of brainstorming is “to use the group effect to generate good ideas and to solve problems.[71:2]” During the workshop two other techniques, provided by Roberson, were loosely used, i.e. the business event technique and viewpoint technique. By using the business events technique the boundaries are set of the part of the public order and safety domain that will be looked at for requirement selection. In this case is the boundary was the managerial level during crisis control. The viewpoint technique is used to decide the use of the models from the perspective of the recognized stakeholders.*

*The brainstorm sessions were done at least monthly at BiZZdesign. Together with two experts from Novay, a research and consultancy organization that realizes ICT-driven innovations in business and government [72], and one expert from BiZZdesign was present. During the sessions various kinds of input was used to decide on the requirements. First, the documents about the domain that were obtained through experts in the public order and safety domain, i.e. TNO, a Dutch organization for applied scientific research [73]. Second, various meetings with experts in the field of public order and safety, scenario development, and game instrument developers. In conclusion the brainstorm sessions combined with the documents and information obtained from various meetings ensures the validity of the requirements for the POS-extension described in this section.*

## 5.1 SELECTING A MODELING TECHNIQUE

Before stating the requirements for the POSML, a modeling technique is selected to provide the basis of the language. The previous chapter discussed various modeling techniques that can be considered state of the art at this moment. To select a suitable technique to use in this thesis we should first formulate the requirements that enable us to make a choice. The requirements that enabled us to select a suitable technique are based on the requirements for selecting enterprise architecture by van den Berg, Blom and van Brandwijk [79]. In their book they compare several EA methods and frameworks. Several of the requirements that are used by van den Berg et al. to compare these methods are used in this thesis to come to a selecting of a suitable modeling language. These requirements are expanded with requirements that are elicited during the brainstorm sessions with modeling experts to eventually come to a solid choice of modeling language.

### Ease of use

The people that are working in the public order and safety domain do not have a technical background and are also most likely not used to working with any kind of modeling technique. Therefore it is important that the chosen modeling technique is supported by some kind of software tool, improving the ease of use.

The requirement ease of use is further divided in:

- Tool availability

For the public order and safety domain it is important to be able to visualize the models in such a way that all stakeholders can understand the made models. This is important because otherwise the intended use of the models in the domain is hard to achieve, since the people in the domain often do not have a technical background and are not used to work with modeling techniques. Therefore the availability of a modeling tool to use and implement the language is important.

- Minimal required technical knowledge

Derived from the previous requirement the level of technical knowledge should be minimal since technical background of the people working in the domain is limited.

### Large expression possibilities

A large expression possibility means the extent to which the language and symbolism provides the means to map enterprise architecture [79]. If we translate this to the public order and safety domain it means that the concepts that define the language are sufficient to be able to address all the important factors of the crisis organization. The next section discusses the requirements for the language in more detail. To be able to model the domain for the purposes of this thesis, it is considered important that the language offers a large expression possibility. Since the fulfillment of this requirement, allows us to model the domain with minimal adaption of the original language.

### Adaptability of the language

Since the use of models in the domain of public order and safety differs from the way it is currently used in other domains, adaptability is the first important aspect in selecting a modeling technique. During the brainstorm sessions it became apparent that the modeling

technique should allow altering the core concepts and relationships to fit the needs of the public order and safety domain. We call this aspect of the chosen technique adaptability.

Availability of various viewpoints

Availability of various viewpoints is a requirement van den Berg et al. [79] and states that it is important to be able to identify with all stakeholders and take their interests into account. This is based on the fact that in every company there are many employees and departments which all have different interests and working ways. The same is true for the public order and safety domain, which has various departments and many levels of hierarchy, expressing the need for various viewpoints.

Modeling techniques→ Requirements ↓	Zachman	Togaf	Modaf / Dodaf	ArchiMate (BiZZ-designer Architect)	UML	BPMN	Amber (BiZZ-designer)
<b>Tool availability</b>	--	-	-	++	-	-	+
<b>Minimal required technical knowledge</b>	-	-	-	++	-	-	+
<b>Large expression possibilities</b>	-	-	-	++	++	++	++
<b>Adaptability of the language</b>	+	-	-	+	-	-	++
<b>Availability of various viewpoints</b>	-	-	+	++	+	-	-

TABLE 13: CROSS TABLE COMPARING MODELING TECHNIQUES WITH REQUIREMENTS

MODAF/DODAF

The MoDAF framework is extensively used by government departments and agencies, this also means it is used for military purposes, focusing on acquisition. The framework provides various viewpoints that could also be useful in the public order and safety domain. The DoDAF framework mainly focuses on the development of (complex) systems. Therefore it would be less suitable for the public order and safety domain and the problem it seeks to solve, because the adaptations that would be needed are too extensive. Both frameworks do not offer a specific language for modeling. It offers a framework with various templates, which are called views, to be filled in. Despite that there are several tools that offer the right functionality to implement the frameworks, they are not considered suitable to use during this research.

Zachman

The Zachman framework follows strict steps for filling out the cells of the framework. The framework does not seem applicable for other purposes than enterprise architecture, because it does require the development of whole new cells in the matrix which makes that the framework cannot be easily used as a basis but rather requires the entire restructuring of the original framework.

## UML

The unified modeling language is a very technical modeling language. UML has a wide functionality and can therefore be suitable for a variety of domains and purposes. However because of the technical nature of the language and the intended users in the public order and safety domain, consisting of mostly non-technical or model experienced people, the language is not suitable for modeling the domain

## BPMB/AMBER

Even though the public order and safety domain works with various processes, the problems that are recognized ask for a modeling technique that enables the creation of models that entail more than just processes. Therefore the process oriented modeling techniques are not suitable in providing models that the problems require.

## ArchiMate

The language of ArchiMate provides for a good basis to model other domains than administrative enterprises. The main reason being the tool that is developed and uses ArchiMate. The tool uses the concepts and notations in Figure 17, but can easily be adapted to fit the need of the intended user. The tool allows concepts and relationships to be added or be included as specializations of existing concepts. The same is true for the visual representation which can be adjusted to suit various representing needs.

## Conclusion

Although there are techniques that seem suitable, the most suitable for modeling the public order and safety domain is the ArchiMate modeling language. The main reason for choosing ArchiMate is because the language is easy to adapt to fit the need of the intended user. Since this need and even the user, defined in the next part of this chapter, varies from the original use of most modeling techniques, ArchiMate is used as basis to create an adapted version of the language and to define the conceptual model for the public order and safety domain.

## 5.2 REQUIREMENTS FOR A CONCEPTUAL MODEL

To construct useful models that contribute to a solution regarding the problems discussed in chapter three, a conceptual model is defined. The conceptual model is the basis of an extension that is made to the ArchiMate language, called the Public Order and Safety extension (POS-extension). The conceptual model provides a generic way to describe specific parts of the crisis organization. Before defining a conceptual model with the concepts and their relationship, the use of the models is determined. This means that the intended users for the models are identified as well as the requirements for the extension.

The intended users, i.e. the stakeholders, are defined during the TOKO project. Since the solutions that the POS-extension seeks to provide are initiated by the project, all the relevant stakeholders can be justified. In total five stakeholders are identified to benefit from the proposed modeling solution.

- Managerial functionary
- Trainee
- Trainer
- (game) Scenario developer
- (virtual) Training game developer

### 5.2.1 REQUIREMENTS ROLE AND TASK RECOGNITION VIEW

The first problem recognized in chapter three states that managerial officials do not always recognize their task, other roles, and the task of other roles in the crisis organization. Therefore the conceptual model should include those concepts that enable a user to express combinations of roles and tasks and the relationships that enable them to specify the linkage between roles and tasks.

The required concepts for the role and task recognition view which are decided during the brainstorm sessions are listed below:

The POS-extension requires the inclusion of a concept to express:

1. The person fulfilling a managerial function in the crisis organization.
2. The managerial function that is performed by a person in the crisis organization and is listed in the functional profiles obtained from experts in the domain.
3. A linkage between a person and his or her managerial function stating that he or she is the one performing that function.
4. The tasks and decisions that are described in the function profiles, and are required to be performed by the managerial functions in the crisis organization.
5. A linkage between the tasks and the functions performing those tasks. There are four different linkages possible between a task and a function. To express these linkages the RACI model is used which stands for responsible, accountable, consulting, and informed. [74]
6. A linkage between different functionaries to express the hierarchical command that exists between them.

### 5.2.2 REQUIREMENTS INFORMATION MANAGEMENT VIEW

The second problem recognized in chapter three was the lack of knowledge of the information sources available to managerial functions in the crisis organization and the information their colleagues processed that are useful to them. The required concepts for the role and task recognition view, which are decided during the brainstorm sessions are listed below. Note that the former requirements are not included, but are needed for the information management view.

The POS-extension requires the inclusion concepts to express:

7. The information that is transferred among different functionaries.
8. A linkage between the information and the functionary in possession of that information.
9. A linkage between different functionary's stating that information is shared between them.

### 5.2.3 REQUIREMENTS TRAINING VIEW

The third and final problem recognized in chapter three was the lack in training. The functions on a managerial level during a crisis are not trained often and efficient enough. Therefore the training view is required to express multiple aspects. The required concepts for the role and task recognition view, which are decided during the brainstorm sessions are listed below. Note that the former requirements are not included, but are needed for the training view.

The POS-extension requires the inclusion concepts to express:

10. The training need of a person in the crisis organization.
11. A linkage between a training need or goal and the person in the crisis organization where the need applies to.
12. The goals that are reached by a certain training exercise.
13. A linkage between certain training goal and the training exercise that fulfills this goal.
14. The performance measure to be able to express a goal.
15. A linkage between a goal and the performance measures.
16. A linkage between a task and the performance measure that is required to fulfill the task.
17. A linkage between a managerial function and the performance measure that are required to fulfill that function.
18. A linkage between a person and the performance measures that he or she has already obtained.
19. The subject and events during a training exercise, combined with several categories indicating the properties of the training as indicated in the TOKO document "scenarioboom".
20. A linkage between the training exercise and the subject and event used in the training.
21. The individual events that are used in training.
22. A linkage between the events and the task or decision that a managerial functionary has to perform given that certain event.





# CHAPTER 6: THE PUBLIC ORDER AND SAFETY MODELING LANGUAGE

*This chapter describes the Public Order and Safety Modeling Language (POSML). The creation of this language is required to be able to model the crisis organization and to research the hypotheses stated in the first chapter.*

## 6.1 THE CONCEPTUAL MODEL

The language that is used as basis for the design of the POSML is the ArchiMate modeling language. The role of ArchiMate is to provide a graphical language for the representation of enterprise architectures [52]. After reviewing the ArchiMate language we found that many of the concepts and relations of ArchiMate fulfill in the requirements that were recognized in the previous chapter. However, since the ArchiMate language is business oriented and the terminology and relations used are not directly applicable to the public order and safety domain, we define a new modeling language in this chapter. The concepts and relations of ArchiMate in relation to the requirements are shown in table 14. Table 14 lists the Concepts and relationships in the left column. After evaluation these concepts and relationships during the aforementioned brainstorm sessions, the concepts and relationships that are needed in the POSML are mapped on the ArchiMate concepts. The right column shows which requirement is met after the mapping.

The ArchiMate and POSML concepts		
Concept and relationships in ArchiMate	Concepts of the POSML	Requirements
<b>Business actor</b>	<b>Actor</b>	1
<b>Business role</b>	<b>Role</b>	2
<b>Business function</b>	<b>Task</b>	4
	<b>Decision task</b>	4
<b>Business object</b>	<b>Information object</b>	7
-	<b>Competence</b>	14
<b>Goal</b>	<b>Learning goal</b>	12
<b>Scenario</b>	<b>Scenario</b>	19
<b>Business event</b>	<b>Event</b>	21
<b>Product</b>	<b>Training</b>	10
<b>Aggregation relationship</b>	<b>Aggregation relationship requires</b>	16, 17
	<b>Aggregation relationship available</b>	18
<b>Assignment relationship</b>	<b>Assignment relationship</b>	3, 5
<b>Realization relationship</b>	<b>Realization relationship</b>	13
<b>Used by relationship</b>	<b>Used by relationship</b>	5, 20
<b>Association relationship</b>	<b>Association relationship</b>	5,11,15
<b>Triggering relationship</b>	<b>Triggering relationship</b>	22
<b>Flow relationship</b>	<b>Inform relationship</b>	5,9
<b>Triggering relationship</b>	<b>Command relationship</b>	6
<b>Access relationship</b>	<b>Access relationship</b>	8

TABLE 14: CONCEPTS AND RELATIONS COMPARED TO REQUIREMENTS

- Task is implemented as a business function because it relates to the functionality of a task that is required. The concept task exists in two forms: a general task and a decision task.
- Competence is a new concept that is not a specialization of a concept in the meta-model of ArchiMate.

The POSML uses the existing meta-model of ArchiMate. The creation of the POSML is done by specialization of the concepts that are important for the domain in relation to existing concepts in ArchiMate. This ensures that the original functionality of the language stays intact while expanding it to fit the needs of the domain.

The meta-model of ArchiMate consist of several parts. A business layer meta-model, an application layer meta-model, a technology meta-model and a motivation meta-model. The business layer is used as basis for the conceptual model POSML conceptual model. The only concept from the motivation meta-model used in the new model is the concept goal. Figure 30 shows part of the meta-model of ArchiMate, i.e. the business layer meta-model, which is used as basis for the concepts of the POSML.

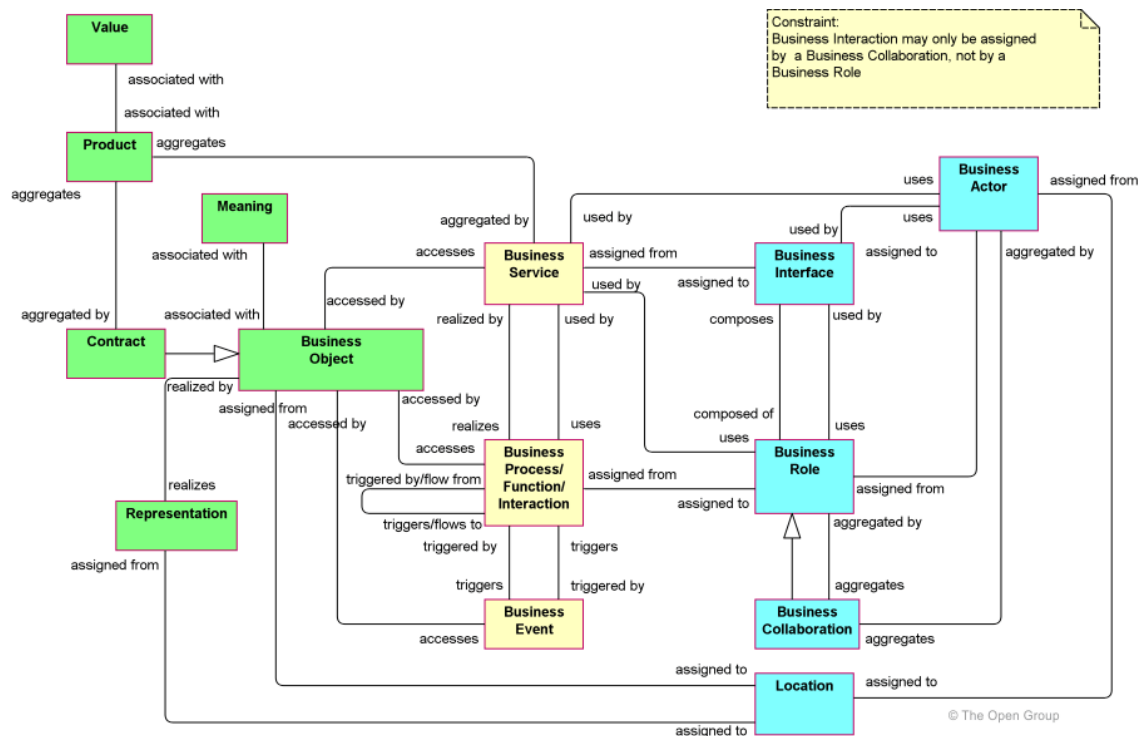


FIGURE 30: BUSINESS LAYER META-MODEL OF THE ARCHIMATE LANGUAGE

Figure 31 shows the concepts of the POSML and the specialization relation between the concepts of ArchiMate.

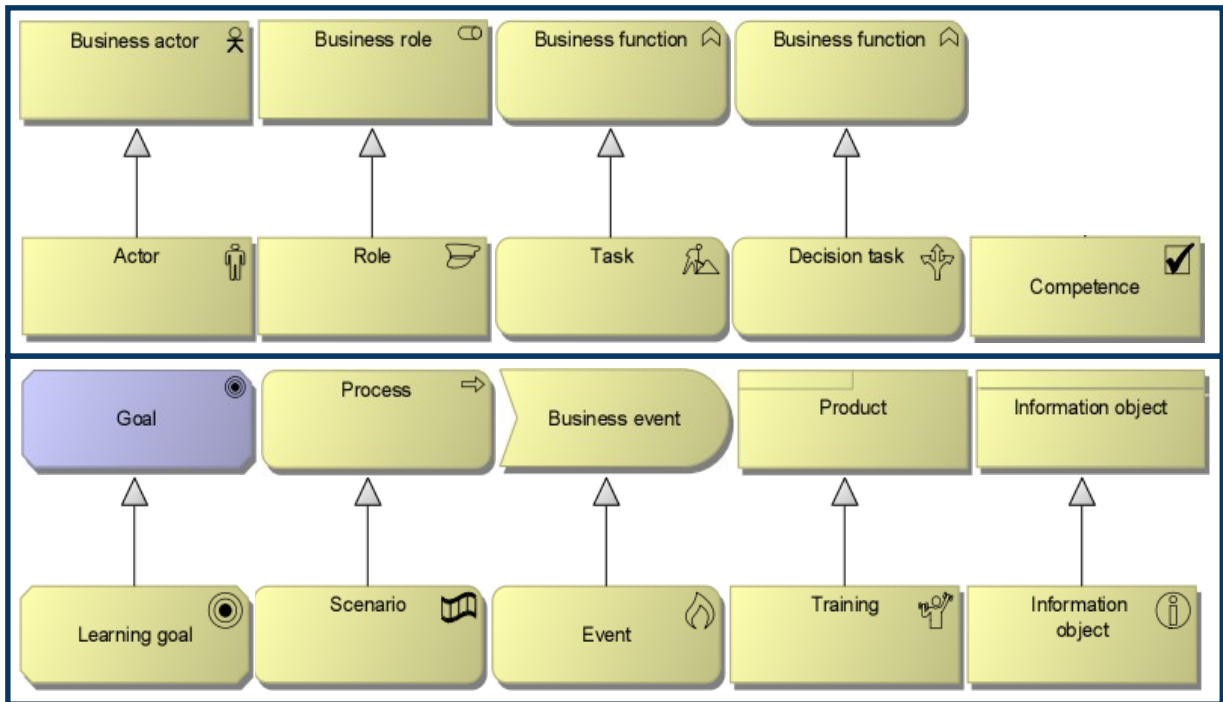


FIGURE 31: ADAPTION OF THE ARCHIMATE META-MODEL TO A CONCEPTUAL-MODEL FOR THE POS EXTENSION

The base of the conceptual model shows the core concepts *Actor*, *Role*, *Task* and *Competence*. This part of the conceptual model represents the first two problems that were recognized: the lack of role- and task recognition and information management. To provide in the 'need for more training', as discussed in the previous section, the concepts learning goal, training, scenario and event are included in the conceptual model. The total conceptual model is therefore defined as indicated in Figure 32, showing the complete conceptual model of the POSML.

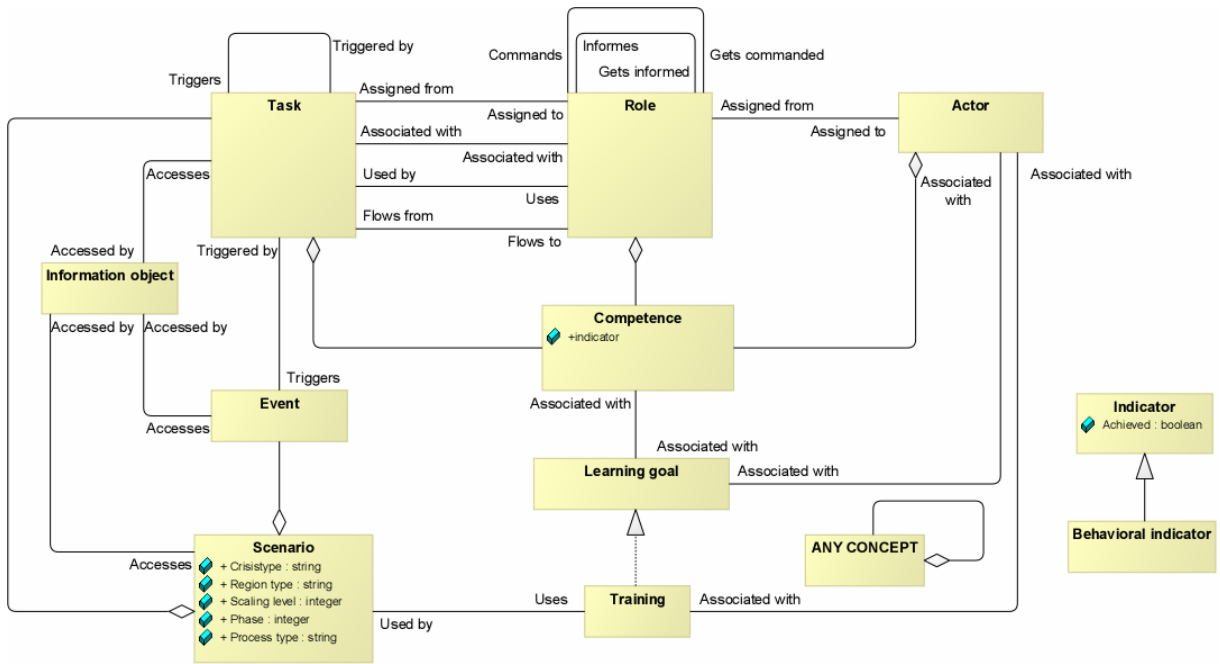


FIGURE 32: CONCEPTUAL MODEL

The next two sections discuss the conceptual model in more detail, giving a visualization and definition of the proposed concepts and relationships.

## 6.2 EXPLANATION OF THE CONCEPTUAL MODEL

This section describes the concepts and relationships as discussed in section 6.2, and explains all elements of the conceptual model in more detail. Each concept is explained with a definition, a visual representation, an explanation for the use and an example.

### 6.2.1 VISUAL ADJUSTMENTS

The visualization used in the POSML differs from the original ArchiMate notation. Even though the original visualization of rectangles with text in the middle and a figure in the right corner can still be used in the extension, other shapes are proposed. These shapes are shown in this section with a description of each concept. According to Moody [75] visual representation are important to consider because they tap into the human visual system. Therefore people like to receive information in a visual form to be able to process it effectively. In this case the choice of presenting the models not with squares and arrows is because the intended end users, i.e. the stakeholders, are not used to work with models. Therefore the figures are chosen in a way that is likely to speak to the imagination of the intended user.

### 6.3.2 EXPLANATION OF THE CONCEPTS

This section explains the concepts that are defined in the conceptual model of the POSML. All concepts are specializations of an existing concept in the ArchiMate language, with the exception of the concept competence, which is newly defined in the conceptual model.

---

#### ACTOR

---

A business actor concept in ArchiMate is an organizational entity that is capable of performing behavior [52]. This definition is adjusted to fit the POSML. Therefore the functionality changes. The concept actor is a specialization of the concepts business actor of ArchiMate.

<b>ArchiMate definition (business actor)</b>	“A business actor is defined an organizational entity that is capable of performing behavior.” [52:19]
<b>POSML definition</b>	<i>“An <b>actor</b> is defined as the person or groups of persons fulfilling a specific (managerial) function in the crisis organization.”</i>

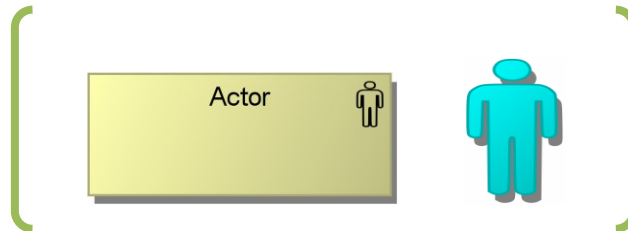


FIGURE 33: ACTOR NOTATION

An actor is an organizational entity; actors may include entities outside the crisis organization, for example victims and partners. An actor may be assigned to one or more roles. This means an actor represents for example humans, departments, and public services. An actor has the ability to ‘have’ learning goals, perform training, and ‘have’ competences. The relations used to express this are explained later in this section. The name of an actor should preferably be a noun.

Example

The example below illustrates the use of an actor. The police department is modeled and is composed of the chief of police and the director of enforcement. The *leader ROT* role is assigned to the director of enforcement. In this role, the director of enforcement performs the task of translating the policy-decision for the CoPI.

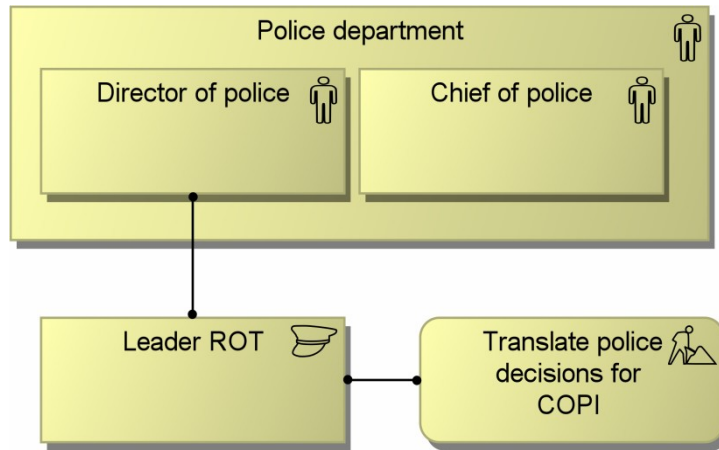


FIGURE 34: EXAMPLE ACTOR

## ROLE

For the role concept the definition is slightly changed regarding the original ArchiMate definition. The concept role is implemented as specialization of a business role in the ArchiMate language. Some relationships regarding the concepts task and competence are added.

<b>ArchiMate definition (business role)</b>	"A business role is defined as the responsibility for performing specific behavior, to which an actor can be assigned." [52:20]
<b>POSML definition</b>	<i>"A <b>role</b> is defined as the responsibility for performing a certain behavior to which an actor can be assigned."</i>



FIGURE 35: ROLE NOTATION

The word business is again neglected in giving a definition of a role. Certain behavior is expressed in the concept task, which can be assigned to a role through four relationships, which are explained later in this section. Furthermore a role 'requires' competence(s) and an actor is assigned to a role. The name of a role should preferably be a noun.

### Example

In the model below, the role Leader ROT is fulfilled by the Director of Police. The leader ROT commands the role Advisor of the Fire Department, which is fulfilled by the chief of the fire department.

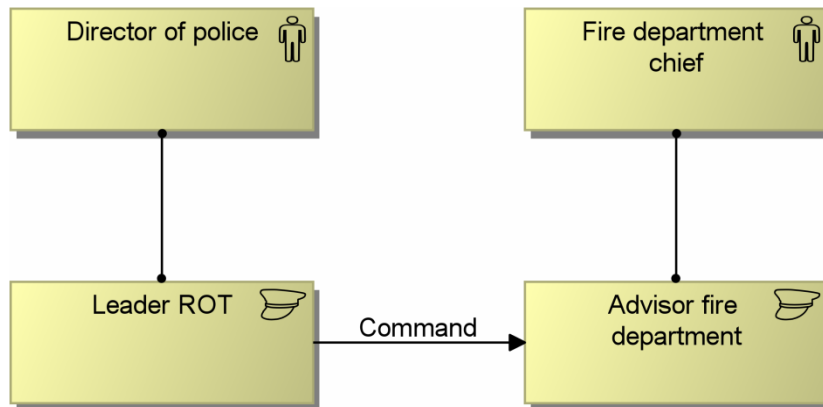


FIGURE 36: EXAMPLE ROLE

## TASK

The way a task is defined, ‘the behavior the role should perform leading to a certain result’, a task is closely related to the ArchiMate concept ‘business function’. This because a business function “groups behavior based on required business resources, skills, competences, knowledge, etc.” [52:30]. This is also what happens in our definition of a task, the behavior that the role performs requires resources (information), competences, and knowledge. Therefore the concept task is implemented as a specialization of the concepts business function in the ArchiMate language. There are two different tasks that are recognized during in the crisis organization: the regular tasks, and decision tasks. Therefore in the POSML these two types of tasks are recognized. However the conceptual model only shows the concepts task since a decision task only differs in its definition, and not in its behavior regarding the other concepts.

<b>ArchiMate definition (business function)</b>	“A behavior element that groups behavior based on a chosen set of criteria (typically required business resources and/or competences).” [52:30]
<b>POSML definition (task, decision task)</b>	“A <i>task</i> is defined as the behavior the role should perform leading to a certain result.”
	“A <i>decision task</i> is defined as the passing of judgment on an issue under consideration.”



FIGURE 37: TASK NOTATION

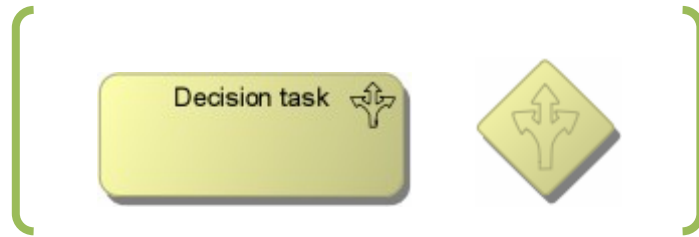


FIGURE 38: DECISION TASK NOTATION

There are four different possibilities to model the relationship between a task and a role. These are explained later in this section. A Task further may be triggered by an event, or by any other behavioral element, so a task can be triggered by another task. Furthermore a task 'requires' the concept competence. The name of a task should preferably be a verb ending with "-ing", or a noun ending in "-ion" or "-ment"; "leading".

Example

In the model below several tasks that are assigned to the role Leader ROT.

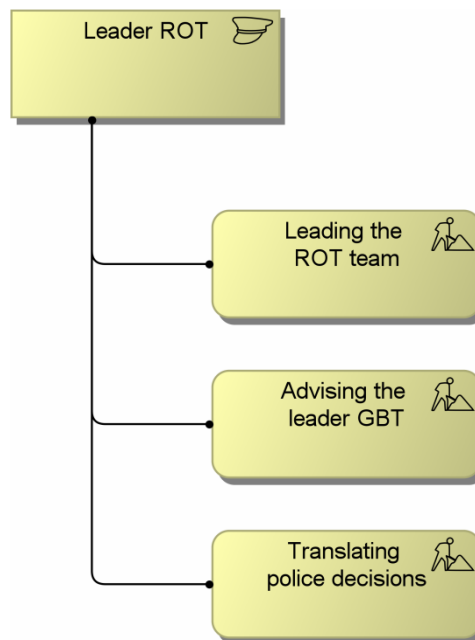


FIGURE 39: EXAMPLE TASK



## LEARNING GOAL

The concept goal has already been introduced in ArchiMate by the motivation extension. The proposed learning goal concept is to be a specialization of the goal concept.

<b>ArchiMate definition (Goal)</b>	"A goal is defined as an end state that a stakeholder intends to achieve." [52:146]
<b>POSML definition (Learning goal)</b>	<i>"A learning goal is defined an observable end state consisting of competences an actor intends to achieve."</i>



FIGURE 40: LEARNING GOAL NOTATION

A goal has an association with one or more competences and one or more actors. Example of goals are: to increase communication competence, improve analyzing competence. Goals are generally expressed using qualitative words; e.g. "increase", "practice", or "improve".

### Example

The model below shows the learning goal that is associated with the Director of Police assigned to the role of Leader ROT. The Learning goal is further associated with three competences; Communicate, Analyze and Decision making. This shows the learning goal of the Director of police is to practice the mentioned competences for the role of Leader ROT.

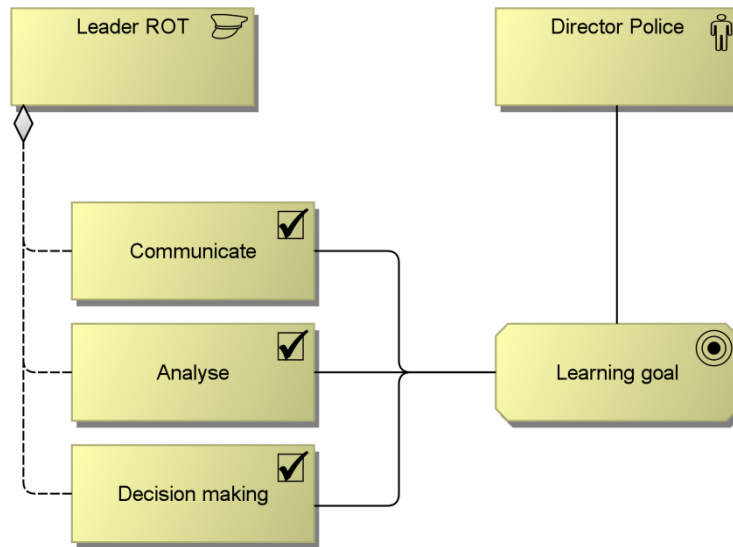


FIGURE 38: EXAMPLE LEARNING GOAL

---

## SCENARIO

---

A scenario can be seen as the story that describes a crisis and recognizes several events as input for the user of the scenario. A business process describes the internal behavior performed by a business role [52]. Even though this is not the case in our interpretation of a scenario, there is a potential many-to-many relation with a business function, (which in this case has task as a specialization) and a process can trigger and be triggered by, for example, business events. These are the main reasons a scenario is proposed as a specialization of a process.

<b>ArchiMate definition (business process)</b>	“A business process is defined as a behavior element that groups behavior based on an ordering of activities. It is intended to produce a defined set of products or business services.” [52:28]
<b>POSML definition (scenario)</b>	“A scenario is defined as a description of a crisis which exists of a series of events, and has five attributes that characterize a scenario.”



FIGURE 42: SCENARIO NOTATION

As mentioned a scenario is implemented as a specialization of a business process. However, the requirements state that there is a need for further specialization regarding a scenario, therefore a scenario is implemented with five attributes stated below:

- *Crisis type:* Type of crisis, e.g. power failure and/or large fire.
- *Region type:* Type of the region, e.g. agricultural and/or industrial.
- *Level of scaling:* The scaling level indicates the magnitude of the scenario and shows what teams are involved. There are 6 levels.
- *Phase:* The phase indicates in what timeframe the scenario is, e.g. the first 18 hours.
- *Process type:* The type of process indicates if the main focus of the scenario is either managerial, supporting or primarily.

A scenario further is related to a training, event, and task, relationships which will be further explained later this section.

Example

The model below shows two scenario's. The two scenario's aggregate several events, indicating the events a trainee will be confronted with if the specific scenario is used in a training.

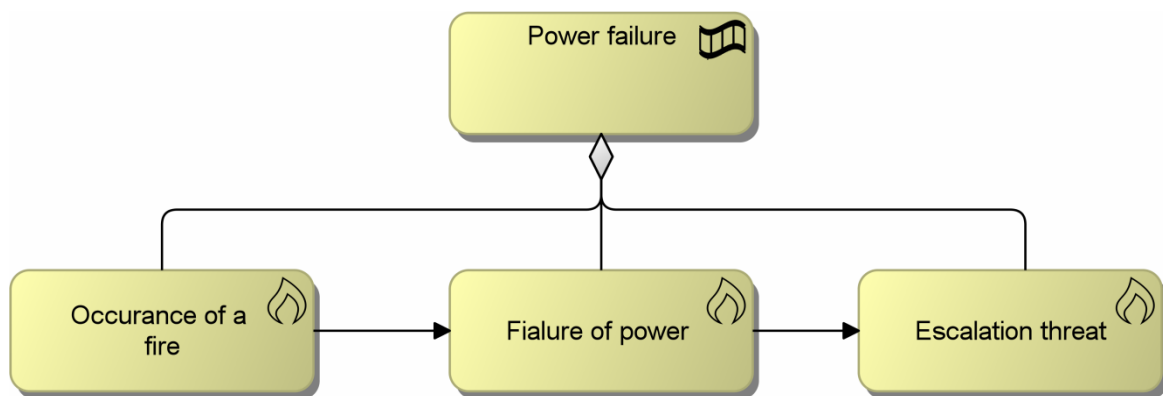


FIGURE 43: EXAMPLE SCENARIO

---

EVENT

---

An Event in light of the public order and safety domain is defined as ‘a happening in a scenario that evokes certain roles to perform a task.’ As a task can be seen as a behavioral element, the definition of a business event closely approaches the intended meaning of an Event as it is meant here; “a business event is defined as something that happens (internally or externally) and influences behavior.” [52:33]. Therefore the business event concept is suitable to be specialized by an Event.

<b>ArchiMate definition (business event)</b>	“A business event is defined as something that happens (internally or externally) and influences behavior.” [53:33]
<b>POSML definition (event)</b>	“An event is defined as something that happens and evokes the execution of a task therefore influences the behavior of a role.”



FIGURE 44: EVENT NOTATION

Events in the POS-extension are related to 2 other concepts. An event triggers a task (or decision task) and a scenario ‘has’ an event.

Example

Example showing several events from a power failure scenario. The events trigger several tasks that are each assigned to a role.

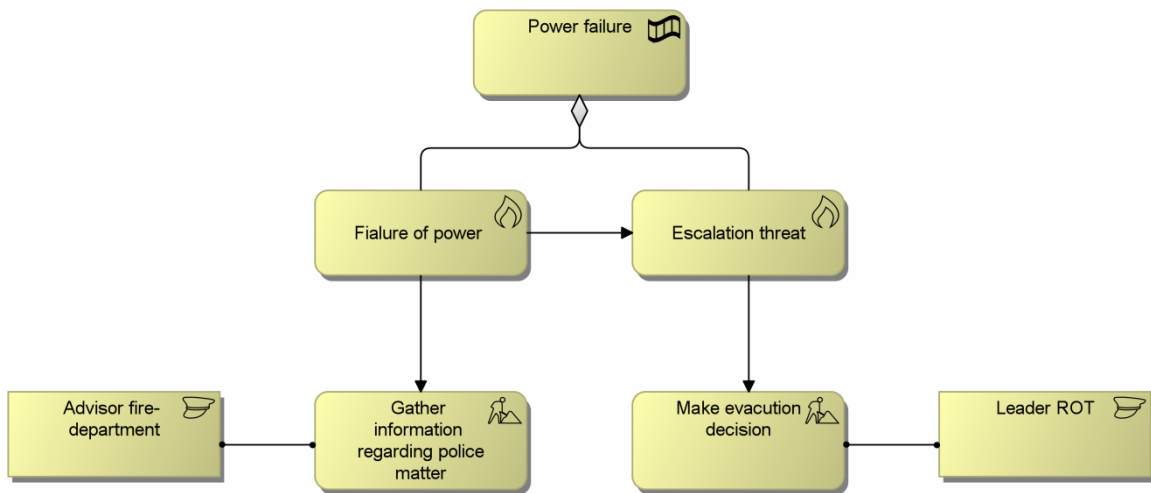


FIGURE 45: EXAMPLE EVENT

---

## COMPETENCE

---

A competence is not easily mapped on an existing ArchiMate concept. Therefore the concept competence is proposed as a new concept to be included in the POSML.

<b>ArchiMate definition</b>	N.A.
<b>POSML definition (competence)</b>	<i>"A competence is defined as the ability of a person or organization to a certain performance, or the necessity of a role to be able to deliver a certain performance."</i>



FIGURE 46: COMPETENCE NOTATION

A competence has an 'indicator' attribute. This indicates the behavior or knowledge that belongs to a specific competence. For example the competence 'communicate' has an indicator such as 'using right terms when speaking'.

A competence is linked to a task and a role through the adapted aggregation relation, stating that a task requires certain competences. The relationship is further defined in section 6.2.4. A competence can further be linked to an Actor through the aggregation relation, stating that an actor 'has' certain competences. The name of a competence can either be a verb, or a noun.

Example

The tasks, which were used in the previous example, require certain competences from an actor. These are assigned to a certain role that is assigned to the task(s). In the example below the competence 'analyze' is required to be able to execute the task 'Gather information regarding police matter' assigned to the advisor of the fire department.

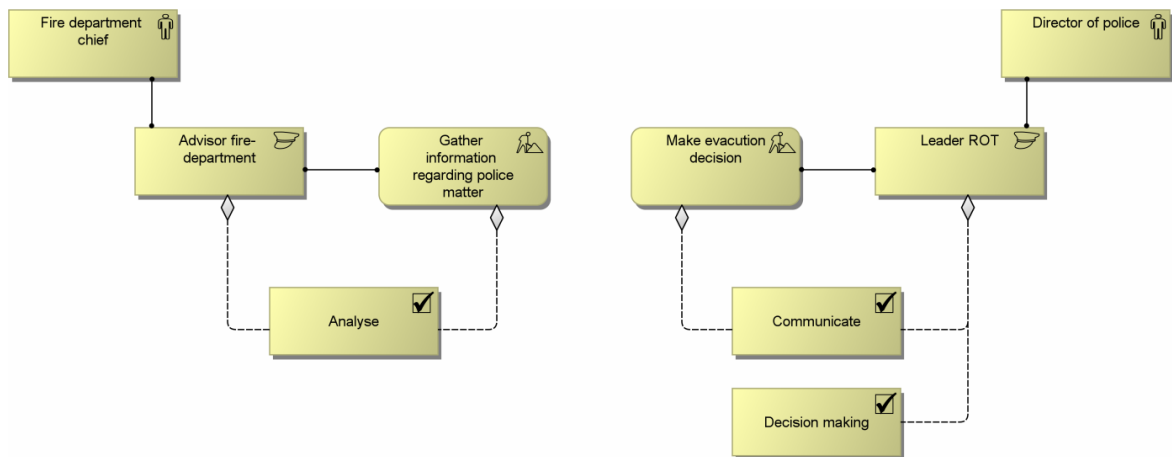


FIGURE 47: EXAMPLE COMPETENCE

## TRAINING

The requirement that explains the behavior of the concept training closely resembles a product in the ArchiMate language. The concept training is therefore a specialization of the concept product.

<b>ArchiMate definition (product)</b>	A product is defined as a coherent collection of services, accompanied by a contract/set of agreements, which is offered as a whole to (internal or external) customers.
<b>POSML definition (training)</b>	<i>A <b>training</b> is defined as a virtual or real life method intended to improve the competences or alter competences.</i>



FIGURE 48: TRAINING NOTATION

The concept training uses a scenario and realizes a learning goal. A training is associated with an actor, because an actor performs the training.

### Example

The model below shows two training that both uses scenarios, indicating what the subject of the training is.

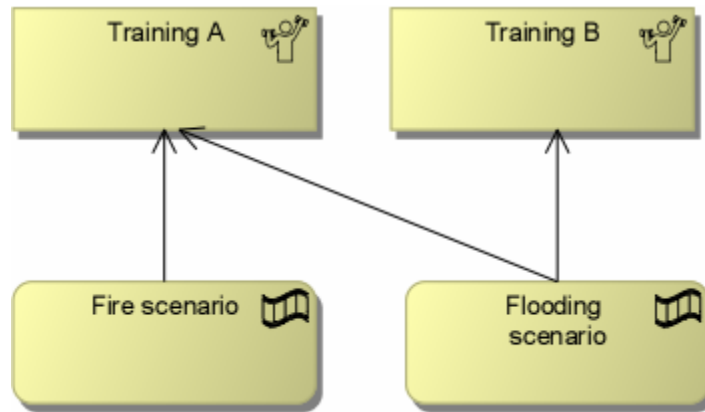


FIGURE 49: EXAMPLE TRAINING

---

### INFORMATION OBJECT

---

The concept information object is implemented as a specialization of business object. The information object models textual information with relevance for the crisis organization. Therefore the characteristics of a business object in ArchiMate are suitable for the POSML.

<b>ArchiMate definition (business object)</b>	“A business object is defined as a passive element that has relevance from a business perspective.” [52:25]
<b>POSML definition (information object)</b>	<i>An <b>information object</b> is defined as a perceptual form of relevant textual information for a crisis, training, or in general for the public order and safety domain.</i>

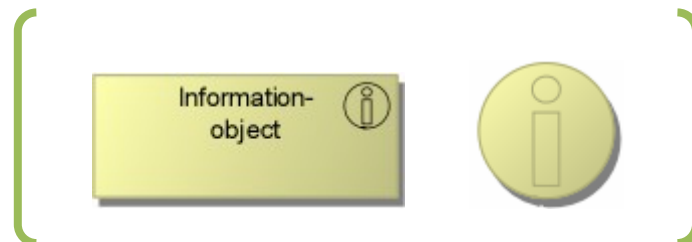


FIGURE 50: INFORMATION OBJECT NOTATION

## 6.2.4 EXPLANATION OF THE RELATIONSHIPS

There are no new relationships in POSML. Also no specializations of existing relationships are proposed. As discussed during the aforementioned brainstorm sessions, the existing relationships in the ArchiMate language are sufficient to express the required relations between the concepts of the POSML. Since the concepts are specializations of existing concepts of ArchiMate the relationships between the POSML concepts already exist. This section described the relationships that are defined by ArchiMate and explains how they are used in the POSML. Not all relationships of the ArchiMate language are discussed only the relationships that are in used in the conceptual model of the POSML.

---

### ASSIGNMENT RELATIONSHIP

---

<b>Definition</b>	<i>"The <b>assignment relationship</b> links active elements (...) with units of behavior that are performed by them, or actors with roles that are fulfilled by them."</i> [52:83]
-------------------	---



FIGURE 51: ASSIGNMENT NOTATION

The assignment relationship typically links active elements of the model [52]. Since the POSML concepts task, role, actor, scenario, and event are specialization of active elements of the ArchiMate language, the assignment relationship exist between the POSML concepts as well. In case of the POSML the linkage is mainly used to relate the actor with a role and a role with a task.

---

### AGGREGATION RELATIONSHIP

---

<b>Definition</b>	<i>"The <b>aggregation relationship</b> indicates that a concept groups a number of other concepts."</i> [52:84]
-------------------	--

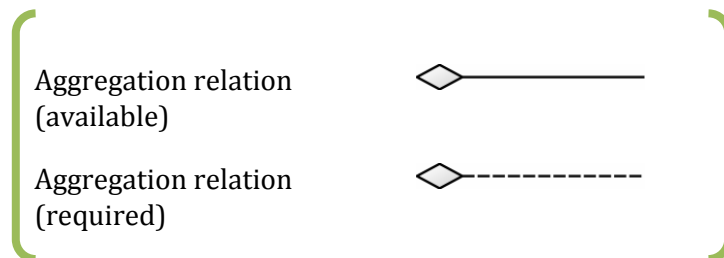


FIGURE 52: AGGREGATION NOTATIONS

This relationship is groups a number of other concepts. In POSML this also means, as indicated in the conceptual model, that the concepts competence can be grouped by task, role and actor. The idea behind this is that an actor can compose of competences, this is done to express that an actor is defined through its ability to perform. The aggregation



relation also exists between task and competence and role and competence. This variation of the aggregation relation indicates that a task and a role requires certain competences, and is visualized with a dotted line.

---

### REALIZATION RELATION

---

<b>Definition</b>	<i>“The <b>realization relationship</b> links a logical entity with a more concrete entity that realizes it.”[52:84]</i>
-------------------	--



FIGURE 53: REALIZATION NOTATION

The only difference in the POS extension opposed to the ArchiMate specification is that the relationship is used to indicate that a learning goal is realized by a training. This is why the original definition is neglected and the definition for the extension only considers the functionality for modeling in the domain.

---

### USED BY RELATIONSHIP

---

<b>Definition</b>	<i>“The <b>used by</b> relationship models the use of services by processes, functions, or interactions and the access to interfaces by roles, components, or collaborations.”[52:85]</i>
-------------------	---

The used by relationship keeps the same meaning as it does in the ArchiMate language, with one expansion. The relationship is used to describe that a training uses a scenario. The definition is adapted to this use in the POS-extension, since this is the only functionality in the conceptual model.

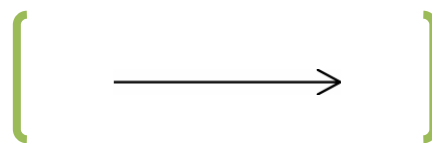


FIGURE 54: USED BY NOTATION

---

### ASSOCIATION RELATIONSHIP

---

<b>Definition</b>	<i>“An association models a relationship between objects that is not covered by another, more specific relationship.” [52:87]</i>
-------------------	---

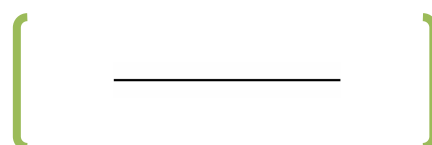


FIGURE 55: ASSOCIATION NOTATION

The association relationship is more extensively used in the POML. The relationship is used to describe the linkage between an actor and a learning goal and a training, indicating that the learning goal and training is associated with a specific actor. The relationship further indicates the linkage between a learning goal and a competence. The visual representation of the association relation is also used between a role and a task, however the relationship is given another meaning specified by the RACI model. The RACI model is described in the next subsection.

---

**TRIGGERING RELATIONSHIP**

---

<b>ArchiMate definition</b>	<i>“The triggering relationship described the temporal or causal relationships between processes, functions, interactions, and events.”[52:88]</i>
<b>POSML definition</b>	<i>“The <b>triggering relationship</b> describes the temporal or causal relationship between tasks, between events and between tasks and events.”</i>



FIGURE 56: TRIGGERING NOTATION

In the conceptual model of the POSML the triggering relation exists between tasks and events, because the concepts task and event are specializations of the ArchiMate concepts business function and business event. We are also able to express the command lines between roles since the triggering relation can be used for interactions.

---

**FLOW RELATIONSHIP**

---

<b>Definition</b>	<i>“The <b>flow</b> relationship describes the exchange or transfer of, for example, information or value between processes, function, interactions, and events.”[52:89]</i>
-------------------	--



FIGURE 57: FLOW NOTATION

The flow relationship is used to indicate information flows between roles in the POSML. The flow relationship of ArchiMate is therefore very suitable to express this relationship and no specialization or introduction of a new kind of relationship is required.

---

---

## ACCESS RELATIONSHIP

---

---

<b>Definition</b>	<i>"The <b>access relationship</b> models of behavioral concepts to business or data objects."</i> [52:86]
-------------------	--



FIGURE 58: ACCES NOTATION

The access relationship of the ArchiMate language is suitable to express the access of a role to an information object since both the role and the information object are specializations of the business role and business object of ArchiMate.

### 6.2.5 THE RACI-MODEL RELATIONSHIPS

Alternative definitions are specified regarding four relationships as they are used between a role and a task. There are four potential relations between a task and a role, which are based on RACI matrix. A RACI-model is a matrix that is used to display the responsibilities of Roles [74]. Where the R stands for Responsible, the A for Accountable, C for Consult, and I for Inform. When a Role is responsible for a task that is the Role that actually performs the task. When accountable for a task the individual assigned to the role is ultimately answerable for the activity or decision. If the Roles relation with the Task is of a consulting nature this means that those individual(s) are consulted prior to a final decision or action. Lastly, the inform relation is assigned to that Role that need to be informed after a decision or action is taken, so the role will be informed about a task. Figure 59 shows a visual representation of the RACI model.

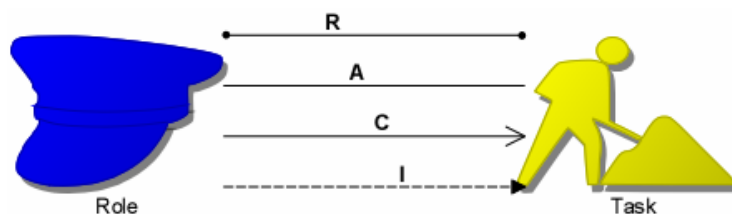


FIGURE 59: RELATION BASED ON RACI-MODEL

## 6.3 EXAMPLE OF USE

Since this thesis is written during an internship at BiZZdesign and the TOKO project provides largely in the motivation for this research, the project provides in an example for the use of the proposed conceptual model. This section describes a scenario that is used throughout the TOKO project and uses this scenario to show the usefulness of the use of models. This section is meant to provide clarity on the intended use of the models. The examples given in this section can also be used for validation, moreover the validation is described in chapter six and seven. The examples given in this section are based on two documents<sup>1,2</sup>.

### 6.3.1 POWER OUTAGE SCENARIO

The scenario is used in the TOKO project and describes an electricity blackout. The scenario subject is chosen by the NIFV for the TOKO project. The argument for choosing the subject electricity blackout is because the various safety regions have calculated the risk for a blackout as considerable, and can therefore identify themselves with the chosen scenario, making it applicable for all regions. The intention of the scenario is that it is used for training with a managerial team. The described electricity blackout covers the GRIP levels 3 and 4 in multiple safety regions and therefore covers a MK, a CoPI, a ROT and a BT. However because the scenario is meant to train the BT team, the actions and messages are described (and need to be simulated during the training) for every team except the BT. The BT consist of several roles which are indicated in figure 60.

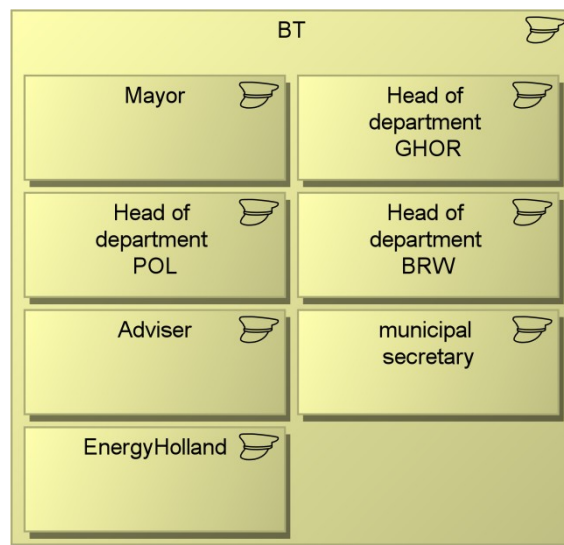


FIGURE 60: THE ROLES IN A BT TEAM

It is important to consider the way the BT works. The main activity of a managerial team is making decisions regarding a crisis. The decision making process is done using the BOB-model, which stands for Beeldvorming (gathering all the information to get a good overview) Oordelen (weighting/judging the situation) Besluitvorming (decision making). The BOB-model is the process that is followed when the BT needs to make a decision. The

<sup>1</sup> Schematische verhaallijn versie 1.0 (04-11-2012). NIFV

<sup>2</sup> Scenarioboom TOKO, uitwerking scenarioboom: rubrieken en indelingen. NIFV

final decision is made by the chairman of the BT, which is the mayor of the municipality, based on the available information and the advice of the advisors in the team. The team follows the BOB-process, however the mayor had final responsibility. The assumption can be made that each individual member of the BT follows the same kind of model, based on their information (which they receive from lower management teams or operational teams). Based on the information that is available to them, their knowledge, experience, and judgment, they make a decision regarding their advice to the chairman. Figure 54 illustrates the collaboration between different teams and the BOB-process. The information messages from the ROT to the BT are described in the scenario document and will be simulated during a training.

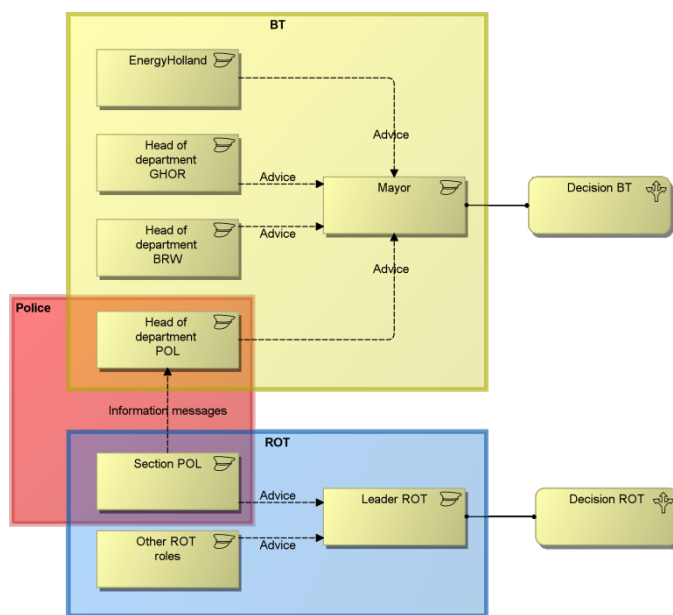


FIGURE 39: COLLABORATION OF TEAMS AND BOB MODEL

One thing that is not considered in the scenario is the link between competences. The use of competences is extensively described in several documents [23][38], however there is no mention of them in the scenario. It can be assumed that the competences are linked to the activities like the BOB-process, since every role has to be competent to perform managerial tasks. For example to perform the 'beeldvorming' every role should be able to *communicate* on a certain level with the roles lower in the hierarchy (e.g. the chief of police in the BT receives information from the police

commissioner in the ROT team). In this case the competence *communicate*. Furthermore for the 'oordelen' the competence *analyze* is required and for the 'besluitvorming' the competence *decision making* is required. The competences that are described in the function profiles provided by the region of Rotterdam are given in Figure 62.



FIGURE 62: COMPETENCES FOR MEMBERS IN A BT

The information that is used for each role in the BT is described in the scenario. The messages each roles receives are thus role-specific. The model presented in figure 63 shows the information messages that are sent to the head of police in the BT that he uses to base its advice on to the mayor. The information provided to the roles are presented in the model as events, since these message describe a certain happening (e.g. fire, explosion, blackout, riots etc.) and the information provided trigger certain tasks for the roles (e.g. analyze information, give advice to the chairman BT etc.).

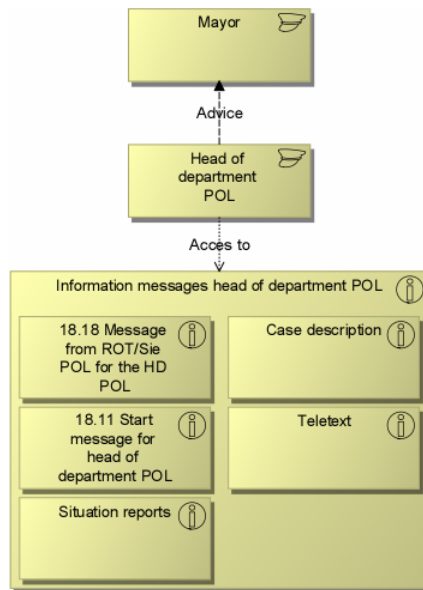


FIGURE 63: INFORMATION MESSAGES SEND TO HEAD OF POLICE IN BT

### 6.3.2 EXAMPLES BASED ON THE SCENARIO

Since every role has their own expertise (police, fire department, GHOR) they might provide different advice to the mayor. The task of the mayor is to make a decision between the possibly conflicting advice. The model presented in figure 64 describes the decision making situation that presents itself at 18.23 in the scenario.

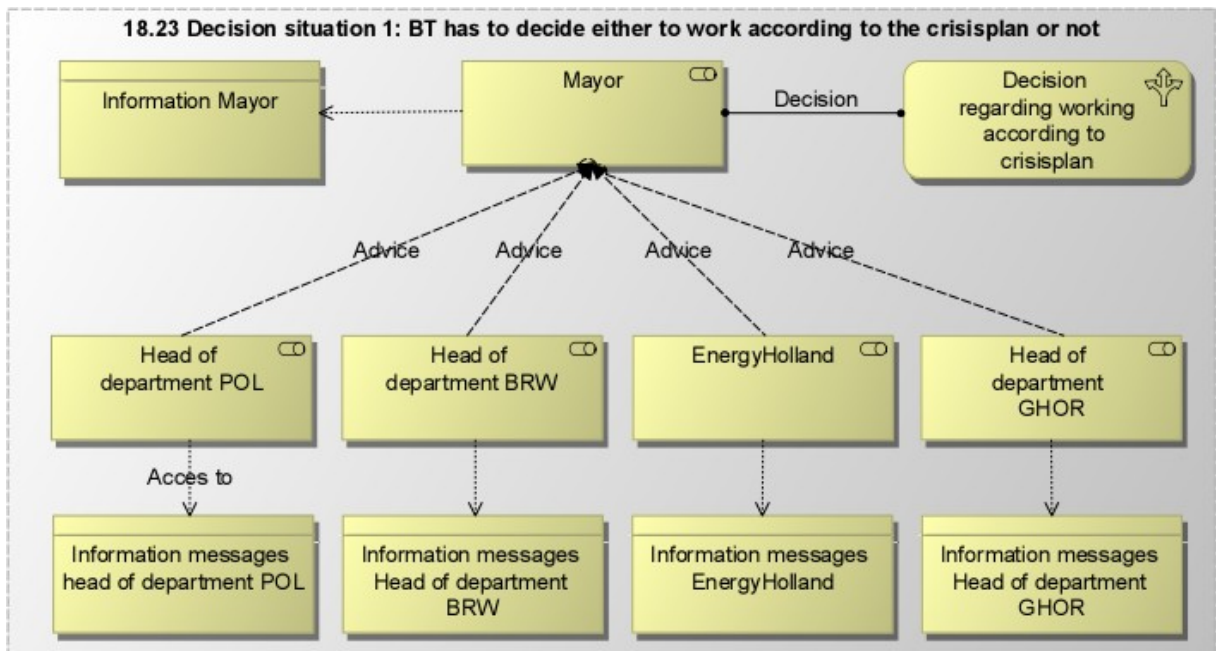


FIGURE 64: DECISION MAKING SITUATION

The model indicates that when a decision needs to be made which information is used by the advisors and the mayor to come to a decision. In this case the decision that need to be made about whether or not the crisis organization needs to work conform a predetermined crisisplan. In figure 65 the color view, a functionality of architect, is used to

give a more detailed image what information is used by which role to prepare advice or to make a decision.

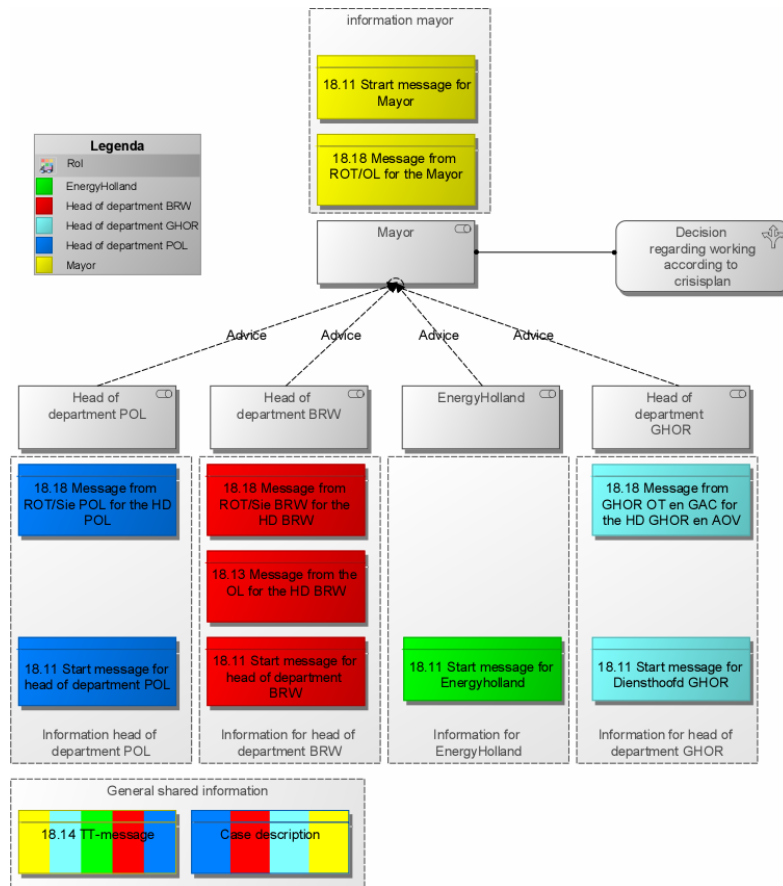


FIGURE 65: EXAMPLE OF DECISION MAKING PROCESS WITH COLOR VIEW

### 6.3.3 EXAMPLES OF THE VIEWS

The following examples are made using the proposed views at the end of chapter three. The examples will be used in chapter seven in a presentation that is given before the interviews. This section elaborates on those examples.

#### Role- and Task recognition examples

Figure 66 shows an example view of a model that contains role-task information during specific GRIP levels. The leader ROT is taken as an example and the model indicates which task the leader ROT has to perform during GRIP 2 and GRIP 3/4. For example purposes not all tasks are shown, but the figure should make clear what the intention is and what the possibilities are. The view first shows the tasks that the leader ROT should perform during GRIP 2, when a disaster becomes more severe and the decision is made by the Leader ROT that there is a need for a higher GRIP level, the task of various roles often change. When the GRIP level changes an extra task 'advising the board (BT)' needs to be performed by the Leader ROT.



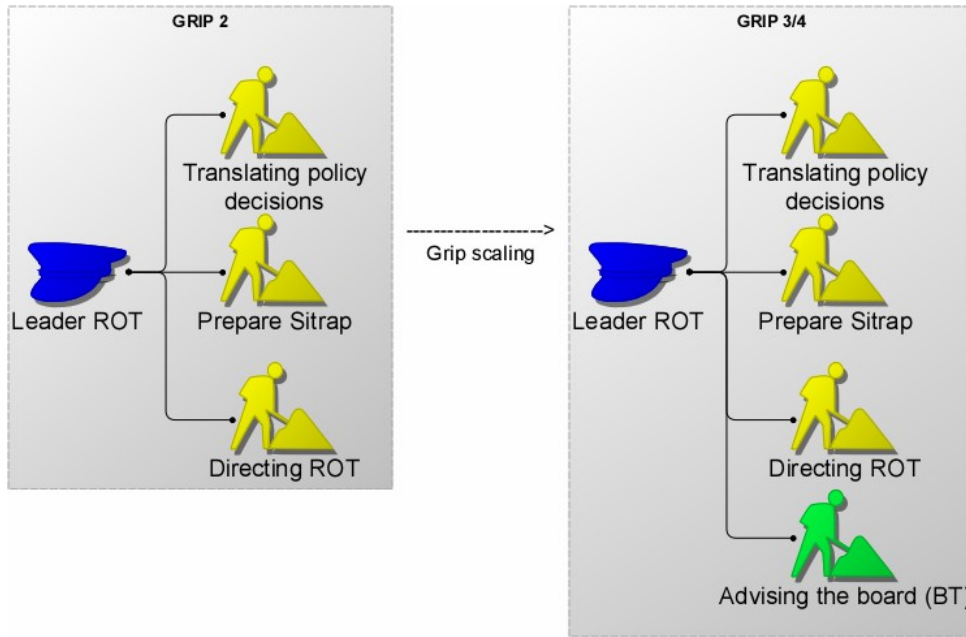


FIGURE 66: LEADER ROT WITH HIS TASK FOR GRIP 2 AND GRIP 3/4

The view shown in figure 67 again takes the leader ROT as an example. In this case the model contains information about the collaboration between various roles. The figure contains 4 different views. Each view is more elaborate due to the expansion of the GRIP and type of crisis. During a GRIP 2 flooding disaster the leader ROT gains advice from his team and the Dutch water board. However when the disaster changes to a GRIP 3, the leader ROT needs to give advice to leader BT. Again this is just an example and the reality is that there are more roles involved in these conditions. This is also the case when the flood reaches a large power source and causes a large power outage. In this case another external role comes into play: the utility company Essent.

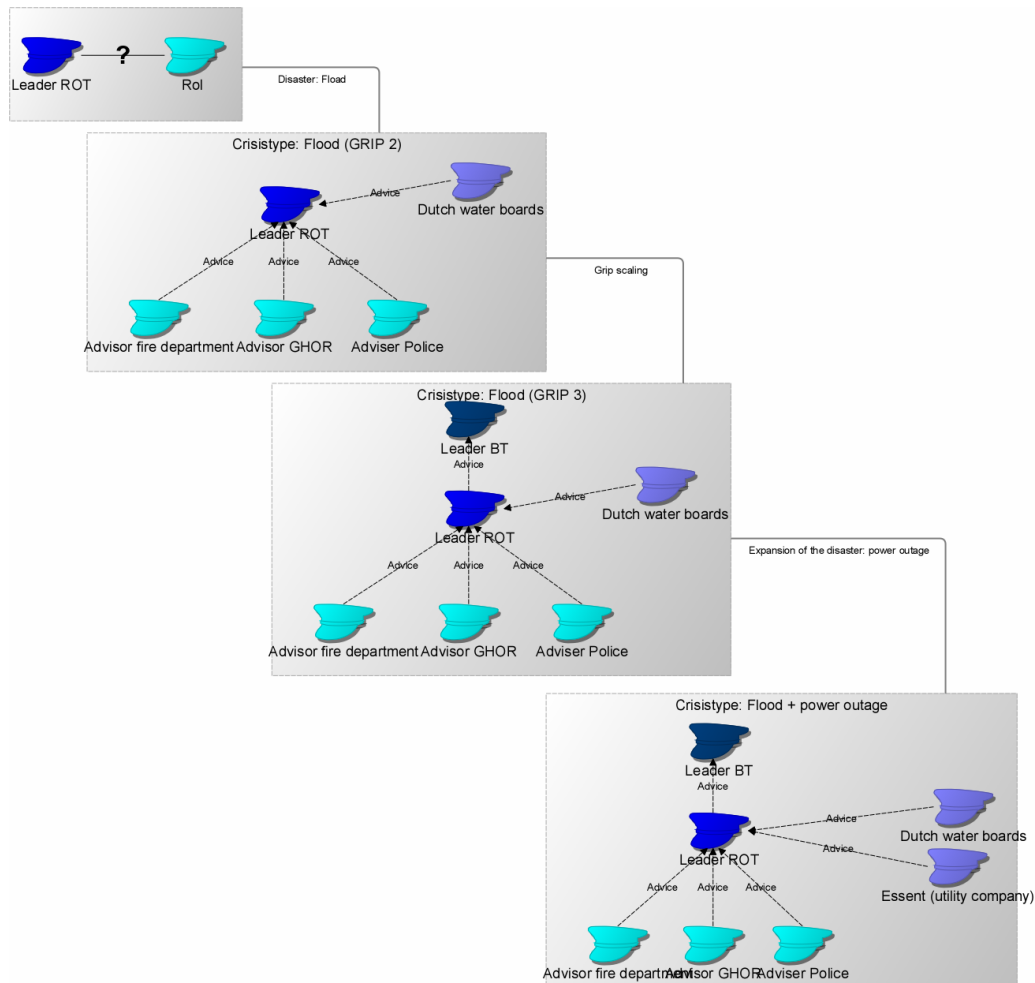


FIGURE 67: COLLABORATION BETWEEN ROLES IN DIFFERENT CIRCUMSTANCES

### Training need example

The example shown in figure 68 is mainly meant for a trainee to choose a suitable training according to his learning goal. In this case an actor that is assigned to the role of leader ROT has a learning goal for 2012 that indicates he or she needs to train three competences. The competence analyze, decisiveness, and leadership are required in this case to perform the task, 'weighing options' and 'making decisions regarding evacuation'. These two task are triggered by the events 'report of a fire' and 'threat of escalation' both of these events are included in a scenario called 'fire scenario' which is used in training A and training B, which makes these training exercises suitable for the actor to satisfy his learning goals.

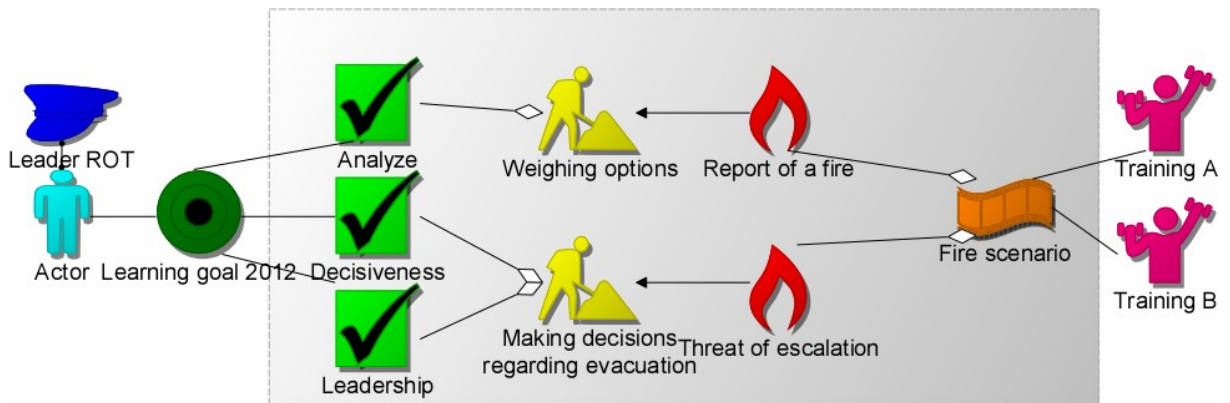


FIGURE 68: FROM A LEARNING GOAL OF AN ACTOR TO A TRAINING

For a trainer it might be helpful to be able to see which events are used in a scenario and which tasks are important to evaluate. The evaluation can be based on the basis of a behavioral indicator that is present as an attribute in the concepts competence. By creating a view as shown in figure 69, a trainer has a the possibility to present the events and tasks that are important to the trainees before a training. Or evaluate the training with his trainees afterwards, in a very visual way.

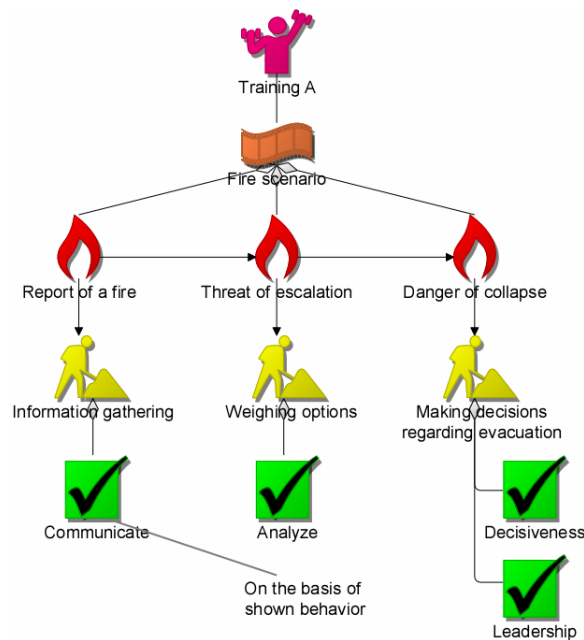


FIGURE 69: VIEW SHOWING THE EVENT AND TASKS DURING A TRAINING

The final example indicated in figure 70 provides the possibility to communicate needs to a scenario-maker. Providing a learning goal, or multiple learning goals, the events that are required to include in a scenario and the tasks they should trigger, can be visually presented. So the needs of a client can be expressed using the kind of view like the one in the figure.

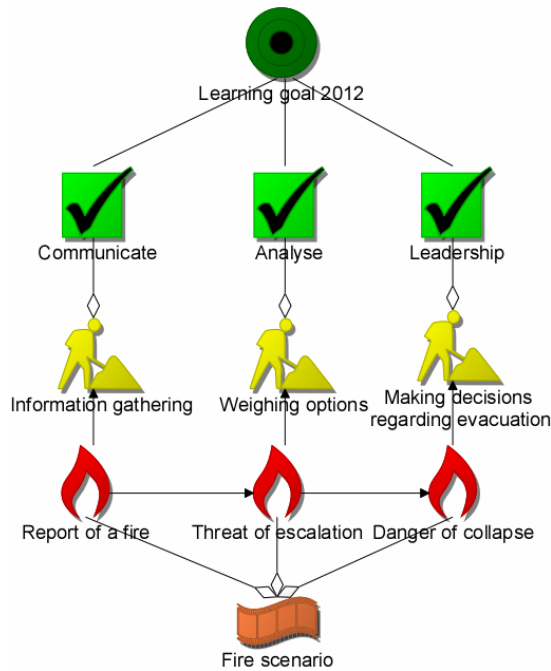


FIGURE 70: VIEW SHOWING THE COMPETENCES, TASKS AND EVENT FOR A SCENARIO

## 6.4 CHAPTER CONCLUSION

This chapter described the concepts and relationships that together form the conceptual model. The concepts that are chosen as requirements for the conceptual model are elaborately discussed during sessions in the TOKO project. There are several options for the use of this conceptual model in the public order and safety domain. The examples given in the last section elaborate on these options and different possible stakeholders. These examples are also chosen during group sessions. The next step in is to validate the used concepts, relationships and the proposed examples of the conceptual model to verify its usefulness.



# CHAPTER 7: VALIDATION

---

As stated in section 1.5 the design science research methodology is used throughout the thesis to come to a solution to the recognized problems. The final step in this method is the evaluation. According to Peffers et al. [13], the evaluation activity can take many forms and is dependent on the nature of the artifact.

## 7.1 TYPE OF RESEARCH FOR EVALUATION

A distinction that is most often made in social research is between qualitative and quantitative research. Quantitative research is based on numerical research data, where qualitative research on nonnumeric data [76]. According to Creswell [77] quantitative research examines the relationship between variables for testing objective theories, where the variables can be measured and analyzed using statistical procedures. Qualitative research, according to Creswell [77] is the exploring and understanding of the meaning that individuals or groups ascribe to a social or human problem. The data for qualitative research is often collected in participants setting, the analysis inductively builds from particular to general themes, and the meaning of the data is an interpretation of the researcher [77]. One definition about qualitative research is given by Denzil and Lincoln [78:3], they state that *“qualitative researchers study things in their natural settings, attempting to make sense of, or interpret phenomena in terms of the meanings people bring to them”*.

Creswell [77] states that if a concept needs to be understood, because little research has been done on it or when a researcher does not know the important variables to examine than a qualitative research is most suitable.

In this study is chosen for a qualitative research because the concepts and processes are not easily quantified, the concept of using models in the domain needs to be understood and is not been previously researched, and the important variables to examine are not known. The proposed solution will not be implemented during the process of this thesis, it will not be used and therefore quantitative methods such as surveys are not applicable because no matter who the intended subjects for the surveys are, they will always lack in knowledge about the proposed solution. Therefore another way of method needs to be used where the solution can be presented in such a way that subjects for validation purposes understand and are able to provide their expertise about the proposed solution. For this purpose qualitative research methods of data collection are chosen. The research is focused on how people interpret the use of the models, the extent to which the used concepts are valid and provide the intended oversight and insight in the domain of public order and safety. The character of the proposed design science research methodology and the conceptual model that requires the validation provide good motives for a qualitative research.

There are two aspects that are validated in this section. Apart from validating the hypotheses, the conceptual model is reviewed as well. Therefore there are three important goals regarding validation, and also three important questions to be answered. The first is the correctness of the conceptual model, which includes the used concepts and relationships. The second and third goal is to research the correctness of the hypotheses. A reminder of what the hypotheses were:

**Hypothesis 1:** *Models can help trainers, training developers and trainees in creating, providing and receive training*

**Hypothesis 2:** *Models can help professionals at a managerial level in the public order and safety domain to gain more insight and oversight in the crisis organization*

Regarding the three validation goals, there are three questions that need to be answered in order to conclude the hypotheses. These questions are:

- Are there concepts or relationships rightfully defined and are there concepts or relationships missing?
- Does the proposed solution help solve the problems regarding training?
- Does the proposed solution help bring more insight and oversight in the crisis organization?

In conclusion the data collection method described next focuses on two general validation aspects:

- Rightfulness conceptual models
- Usefulness of models in the public order and safety domain

## 7.2 DATA COLLECTION METHOD

Creswell [77] recognizes four basic types of data collection; observations, interviews, documents, audio-visual materials. Audio-visual materials are not suited in this case, because there are no forms of photographs, art objects, videotapes or any form of sounds to be observed. The other three are used to provide in the required data to evaluate the conceptual model proposed in chapter five and the hypotheses in chapter one.

### 7.2.1 DOCUMENTS

According to Creswell [77] qualitative documents may be collected during the process of research. These can include public documents or private documents [77]. In this case the several documents were used the preliminary research, i.e. the conceptual model created in chapter 5. Various private documents were used such as e-mails, presentations given by partners in TOKO, as well as public documents such as official rapports. Official rapport of the Fireworks Disaster Enschede, Chemie-pack, and Volendam new-year bar fire and the three large disaster exercises were used to recognize the problems in the domain of public order and safety. For the recognition of concepts that were used in the creation of the conceptual model public and private documents were used, e.g. official rapports, e-mails and presentations.

## 7.2.2 SEMI STRUCTURED INTERVIEWS

The collection of the data that is required for the evaluation step, semi-structured interviews are used. The interviewees are experts in the domain of public order and safety, trainers for the managerial level, experts in writing a scenario, and experts in the field of modeling as discussed in chapter five. According to Creswell [77] qualitative interviews are conducted face-to-face, via telephone or through focus group interviews by the researcher. In this case the interviews were held face-to-face. There are several advantages of using semi structured interviews as opposed to structured interviews. Semi structured interviews are well suited for the exploration of perceptions and opinions of respondents, and the use of standardized interview schedules are precluded because of the various professional, educational and personal histories of the sample group [77]. Therefore semi structured interviews are suitable in this case, since the beliefs and motives of various experts with different backgrounds are sought to validate the proposed hypotheses. Even though a semi structured interview method is used, a protocol is prepared to give context and some sort of structure to the interview, leaving enough room for the interviewee to elaborate. The protocol can be found in appendix B and is based on [77].

The persons that are interviewed are selected based on their expertise and association with TOKO. A total of six interviews are held, at Bizzdesign, Novay, NIFV, TNO, Thales and T-Xchange. The variety of companies selected ensures that the opinion and expertise of every stakeholder, selected in chapter five, is used for validation. NIFV has their expertise as trainer for the public order and safety, TNO as scenario writers and domain experts, covering the trainee, stakeholder as well, Thales and T-Xchange as training game developers, and finally BiZZdesign and Novay which provide modeling expertise. The stakeholder 'managerial functionary' is not interviewed, however since TNO has the domain expertise they will be able to express the opinions of the people working in the domain, i.e. managerial functionaries, to some extent.

## 7.3 DATA ANALYSIS

In this section the collected data is analyzed. The interviews are analyzed according to the two validation aspects. Each subsection gives an interpretation of the most important opinions of the experts. A summary of the interviews can be found in appendix C

### 7.3.1 RIGHTFULNESS CONCEPTUAL MODELS

The overall opinion of the interviewees is that the concepts that are proposed are complete and that the concepts correspond with the terminology used by them. However every interviewee mentioned some side notes of possible improvements, adaption or criticism which are discussed next categorized according to concept. Some of the concepts are discussed in short together and some more elaborate dependent of the amount of side notes given by the interviewees. The relationships of the POS- extension are not separately discussed since there were no mentions of changes of improvements by the interviewees.

### Actor, Role, Task

These three concepts are the most straightforward concepts and there were no comments on them by the interviewees. The interviewed trainer acknowledged that there were several relationships possible between a role and their tasks, and that at the higher managerial level the decision task became more important. The conceptual models provide the possibility to express these relationships.

### Scenario, event

The opinions of the interviewees about the scenario and events were somewhat divergent, especially between the two interviewed training developers. The interviewee from T-Xchange stated that first of all it should be very clear what type of scenario is represented by the concept, since evidently there are several interpretations of the word scenario. The interviewee distinguishes roughly two, a context scenario, giving a description or story about what happens, and a game-scenario, which are adjusted context scenarios that are better suitable to be used for creating a game. So in regard to the rightfulness of the concept, this is questionable according to the interviewee from T-Xchange.

The opinion of the interviewee of Thales and the feedback given focuses more on the concept event instead of the scenario. He states that despite the fact that a scenario exist of events that shows what happens and in what consecution, a important consideration is the fact that this different when it is used for a game. During a game for managerial functionaries is not the events that are important but the messages that are send out to the trainees that evoke the players to take action. Just as in real life the higher in the hierarchical chain of crises control, the more they are dependent on the information flow than on the actual fire, flood or whatever other disastrous occurrence. Therefore if the event also represents the messages that are send to the players, the conceptual model is seemingly correct.

A final justification of the scenario and the attributes created comes from the interviewee of the NFIV. The initial idea of the characteristics of the scenario came from the NIFV and TNO, and the ability to ascribe these characteristics to a scenario is correct. The initial idea of the attributes included the concept competence as an attribute. The decision to create a separate concept and make that concept an important part of the model is supported by the interviewees.

### Competence

In the POS-extension the concept competence is at the heart of the conceptual model. This illustrates the importance that is expressed by the interviewees for the concept competence. When creating a game the goal should always be what drives the creation. The improvement or training of competences trough a game is therefore a very important part of models created for training purposes.

Even though the concept is thought of as very important there are several difficulties with the concept that is recognized by the interviewee of the NIFV. The competences required for every function in the crises organization are created by a committee. Another committee writes the functional rappers stating the tasks and responsibilities for every role. Therefore it is very difficult to actually ascribe a 1-to-1 relation between tasks and competences. However during a training session the assessment of the execution of a tasks is done by checking the behavior expressed by a role during this session. Therefore when competences are combined with some kind of indicator it will strengthen the link between



competence and task. The consideration that should be reviewed is if the indicator should be modeled as a separate concept or as it is currently implemented as an attribute of concept competence.

The second difficulty with competences is that it is currently not used as a measure of performance. Trainees are required to train in different crisis situations. Even though the competences are officially recognized the training of a variety of scenarios and situations are considered more important. Therefore it should be considered if the concept should be adjusted to be able to add some sort of gradation to competences, indicating in what context the competences are trained.

#### Learning goal, training

The only criticism expressed by the interviewees regarding learning goal is that it often entails more than only competences. As stated above the context of the training is considered very important in the domain. This reflects in the learning goal. The goal for an actor does often not only state the competences that should be trained, or were trained, but more often the situation of a training and the subject. For example, there are various types of fires, a goal can be that an actor should train at least with four types of fire scenarios. The consideration of adjust the concepts competence covers this criticism.

#### Missing concepts

The interviewees expressed the wish for two adjustments regarding the conceptual model for the POS-extension. First wish expressed by the training developer from Thales is the inclusion of an information object concept. The reason for this concept is that during a training game the information that is exchanged between roles is a leading element of the training. The information triggers (decision making) tasks and are based on events described in the scenario. So either a new concept should be introduced or the definition of event should be adjusted. However the creating of a new concept is preferred because it differs from events because information should relate to roles that send and receive information.

The second need for an adjustment is expressed by the interviewed trainer. The functionality is present in the POS-extension as an attribute of competence, however since the importance of a competence indicator is thought of by as very important by the interviewee is deserves consideration to include the indicator as a separate concept in the conceptual model.

#### Conclusion

The overall conclusion is that the semantics that are often used in the public order and safety domain are present in the modeling language. A few changes might be required, however this will become more apparent when models are actually used in the domain. The latter indicates the need for a more elaborate user evaluation.

### 7.3.2 USEFULNESS OF MODELS

The usefulness of the models is expressed with reference to the examples shown in the pre-interview presentation. The overall opinion of the interviewees is that the examples that are shown can indeed be a useful contribution in the public order and safety domain. Every interviewee thought of the stakeholder specific example applicable to them as useful and adding value. The opinions of the experts are discussed next sorted according to stakeholder.

#### Trainee/ managerial functionary

The NIFV has a lot of experience in giving training to the domain of public order and safety, for this reason the use for models for trainees and also managerial functionaries are discussed with the interviewee of the NIFV.

A useful functionality of the models for trainees is given by the view that shows the tasks that are required to fulfill by a role. For the more experienced managerial functionalities this might not add value, however the view can be very helpful for inexperienced members of managerial teams that do not know their task and the tasks of their colleagues by heart. The trainee is able to create a quick and clear overview of the information that is required on every given moment.

#### Trainer

Several useful applications for models are recognized by the interviewee. First of all, the example that is shown and meant for a trainer is very useful. A trainer is able to show a trainee which competence will be trained and which behavior is sought after, the model support this communication. The interviewee even indicated that he would like to make use of the modeling extension as support during a training that is forthcoming. A second communication use of the models is between the trainer and the client that hires them. Often the client does not really know what the competences and indicators are that needs to be trained, they do not know exactly what they want to have trained. These kinds of models can support this by presenting the possibilities and training goals in a clear manner.

The interviewee concludes with the notion that the examples should be made more extensive and should cover a complete scenario and training. This will create the possibility to present the idea to people actually working crisis management teams and gain even more feedback.

#### Training game developer

Two interviews were held with training game developers, T-Xchange and Thales. The interviewee of T-Xchange sees the use for models as minimal. Models can provide in domain information and used to, together with a domain expert, become a first order expert. Also it can be helpful to select a training that an actor can attend according to its learning goal. When creating a game however, models are not so useful. Regarding domain information, it is not feasible to model all the domain information because it is subject to change in short periods of time. Furthermore the creation of a suitable game scenario and a training game in general is 'craftsmanship' and cannot be captured by models.

The interviewee of Thales states that models containing domain information, e.g. task combined with roles, are very useful input for game developers, when creating a domain specific game. This is especially true for scenario specific models which contain events and

messages that are important to include in a training. These models can be created by scenario developers communicating their wishes to a training developer. When a scenario is now presented to a game developer, often only the events and information is included but not the task and collaboration of roles. Models can help in this case and prevent the game developer from losing a lot of time doing research into the domain. However to be able to see the added value of models there is a need of a clear and realistic example. The TOKO project offers the possibility of using the models to create a scenario and use both the scenario and models to come to a training game. This will show if the models can really bring clarity and help in the creation of a training game.

### Overall remarks

Next to the interview with several domain experts, an interview was also conducted with modeling experts of BiZZdesign and Novay. With many years of experience in using modeling techniques at administrative companies, as well as the use of models in project in other domains, the modeling expert have a solid understanding of the abilities of models. This reflected in the interview that was held and the overall opinion was that models should be able to bring clarity and oversight to the complex domain. Models have proven to be useful in other domains helping companies that became very complex over the years just as their environment to gain insight and help change these companies in a structured manner. The public order and safety domain can be seen as a large complex organization, therefore models should be able to offer advantages in the domain. The partners of the TOKO project are generally positive about modeling, and can be useful in the domain.

The power of models is the visualization of information that is generally stored in large documents. This visualization is enforced with the possibility the tool that is used offers to make and present the models and use colors and can be adjusted to fit the need of the intended users. Analyzing is another advantage of using models. By including the variety of documents in the models the tool can do calculation and show differences or inconsistencies that were not visual before.

### Conclusion

The overall impression about the usefulness of models in the domain is positive. In general the interviewees see the possibilities for the use of models, especially for providing information about the domain regarding the roles, task and collaboration, as well as communication and information provision between scenario developer, training developer, trainers and trainees. Despite the general positive reactions, the interviewees share one opinion, which is that the use of models will become even more apparent when it is used as intended and shown in the pre-interview presentation.

## CHAPTER 8: FURTHER VALIDATION

---

*This chapter describes another way of validation to research the use of models in the public order and safety domain. In the previous chapters, semi-structured interviews and brainstorm sessions were used as methods for data collection. The data that was gathered through these methods was used to validate the rightfulness of the conceptual model and the usefulness of the models for the domain. The semi-structured interviews gave reason to a more practical validation approach, since the experts recognized that to be able to confirm the hypotheses, the models should be made and tested in the domain. This chapter proposes such a practical method and described how views can be created during the TOKO project for further validation. The TOKO project will form the basis for this approach, providing a scenario that is developed during the writing of this thesis. The scenario is described at the end of chapter five. Because of the time-constraint the practical validation is not done during this research.*

*Three views were proposed at the end of chapter three for providing insight and oversight and help in developing, giving and receiving training exercises:*

- *Role recognition view*
- *Information management view*
- *Training view*

*Examples of these views are given in section 6.3.*

### 8.1 CREATION OF THE VIEWS

The TOKO project offers opportunities to make these views with the help of various experts, possessing knowledge about the domain in general, training and modeling. Making these views together with experts allows us to see if the models can be realized. The next step is to test if the made views actually provide more oversight and insight into the domain of public order and safety and if they help to develop, give and receive training. This can also be done during the TOKO project. Data should again be collected after a training was created and the models were used during that training. This data collection can also be done by conducting several semi-structured interviews about the use of models during the project. Because the members of the TOKO project are all experts in their field they have spent prolonged time in the field and are able to share their experience with models and compare this with their normal working methods without the use of models. This gives a more concrete validation of for the use of the models in the domain.

For the creation of the views the power outage scenario is used, as described in chapter 6.3, to provide the context for the case. Each step of the case is described below and based on the three proposed views.

### 8.1.1 ROLE RECOGNITION VIEW

The scenario describes the event of a power outage as a result of a fire at Energy Holland. Since in this case the BT team is trained, the scenario describes the various messages that form the input for the BT team. These messages describe the occurrences of the crisis and the consequences thereof, and are the events that trigger the team to take action. The actions that the BT has to take, i.e. their tasks and decision tasks, and the roles and teams that are involved in the crisis are input for the role recognition view.

The view should provide more oversight and insight in the roles and tasks involved, as well as the task they are supposed to perform, instead of the documents that are currently used to provide this information. This will provide benefits to the training-developer and trainee. The training-developer can use the view as information about the domain and which roles and task to trigger during a training. The trainee benefits from the view in terms of role and task recognition as was the problem during crises and training exercises in the past, as discussed in chapter three.

The model can be made in collaboration with the NIFV and TNO, which are experts in the domain of public order and safety.

### 8.1.2 INFORMATION MANAGEMENT VIEW

The information management view shows the information flows. It shows what information is available to what role, and how the information is shared. This will help the trainee by indicating what information he has available, what colleague has that information to share and with who, or what team, the information should to be shared. This will provide a way to prevent the information related problems during crises and training exercises in the past as discussed in chapter three.

This part of the model can also be made in collaboration with the NIFV and TNO, since they have the knowledge and contacts to accurately fill in the required information.

### 8.1.3 TRAINING VIEW

The training view has as purpose to help training-developers in developing a training, trainers in giving training, and trainees in receiving training. It could help training-developers to receive the important information of the scenario in a structured manner. So instead of a scenario written down in documents, the training-developer would receive the scenario as views on a model. This way the important aspects of a scenario that should be used in a training can be presented to the training-developer, which enables him to create a training game in less time and with higher quality.

For a trainer and trainee a training view has the advantage in the briefing and debriefing of a specific training. During the briefing a trainer can use a training view to show the events that are going to occur during a training and the behavior that is expected of the trainee(s). During the debriefing of the training, the trainer can walk through the events that were important. Moreover, the behavior, competences, or tasks can be discussed using the models.

This view can be made with the NIFV and Thales, since the NIFV created the scenario and Thales is willing to create a game based on the scenario.

## 8.2 CONCLUSION

Now that the views are made and used for developing a training and during a training, interviews should be conducted to provide research data about the use of models. After the application of the models as described above, the involved experts should now be able to compare the use models in their work or training with the work or training without models. We should therefore be able to conclude about the hypotheses of this research.



# CHAPTER 9: CONCLUSIONS AND DISCUSSION

---

In this final chapter the research questions are answered and the hypotheses are discussed. Moreover, the limitations are discussed, suggestions with regard to further research are made and recommendations are presented.

## 9.1 CONCLUSIONS

Crises and disasters always have a great impact on people that are involved. Even years after a disaster the physiological and sometimes physical consequences are still felt among those that were involved. The government has implemented various laws and risk assessments to prevent crises. Also crises control has received a lot of attention over the last decade. Despite the implementation of these measures, past crises have shown that it is hard for crises fighters to switch to a intensive cooperation with each other.

The words crisis and disaster are often not used in accordance with the definitions that are developed in various official government documents. The way that the word crisis is used in regard to the problems recognized and the provided solution, ask for a general definition that is more suitable. Therefore we proposed a general definition for the word crisis:

*“An event that creates a serious disturbance of public safety, where national security might be at stake and the coordinated use of services and organizations of various disciplines is required to eliminate the threat or reduce adverse effects.”*

Many organization have benefited from Enterprise Architecture (EA) modeling and Business Process Modeling (BPM) in reducing organizational complexity. Tamm et al. recognizes four benefit enablers that show the advantage of EA; organizational alignment, information availability, resource portfolio optimization and recourse complementarity. Similar to business organizations, crisis organizations are characterized by structural complexity (many loosely coupled units), hierarchal relationships (many levels of command and reporting) and procedural rules (many constraints on how to act or operate). The advantages EA has on organizational alignment makes that the involvement of relevant people of the crisis organization is stimulated, which positively affects the knowledge of the presence of other roles and other partners. The information availability benefits may help to communicate between regions, and make that there is more uniformity about the interpretation of laws.

To research the possibilities of using EA modeling as a solution for the problems that are recognized in crisis control the main research question is as follows:

***Mq1: How can existing modeling techniques be used to model the domain of public order and safety to improve oversight and insight in the domain, and to help professionals with creating, providing, and receive training, of the managerial level regarding disasters and crises?***

To be able to formulate a clear answer to the main research question several sub questions were derived. These subquestions are answered next, where after the main question is answered. After the answer of the question the limitations of the research are discussed and the recommendations and future work are given.

***Sq1: How is crisis control currently organized in the Netherlands? And Sq2. What problems occur at a managerial level during the response of a disaster and crisis?***

A wide variety of rules and laws are in place in the Netherlands to prevent the occurrence of crises and provide a structured hierarchical way of crisis control when a crisis does occur. One important law that is implemented during the last years is the law safety regions. The law divides the Netherlands into 24 safety regions and gives responsibilities of crisis control to the board of each of the regions. Several reports provide a framework for the safety regions to arrange their crisis organization. The general framework for crises prevention and crisis control is the safety chain, which prescribes different phases every safety region should implement. The safety chain consists out of two main phases, namely the risk control and crisis control. In the risk control phase, scales are made for minimize the risk in every region in order to prevent a crisis from happening. In the crisis control phase, arrangements are made for the crisis organization how to respond to a crisis. The latter is the focus of this research.

The most important change over the last years is the creation of the GRIP reference frame. GRIP states when the variety of preretirement operational and managerial teams available should be involved depending on the severity of the crisis. During GRIP levels three and four the managerial teams are involved for tactical and strategic decision making. By researching several crisis rapports of past crises and the evaluation rapports of large multidisciplinary training exercises it became clear that there are several problems that occur on these managerial levels.

The problems that are recognized can be divided in three main groups. First of all there is the recognition of roles and tasks by managerial functionaries in the crisis organization. It becomes clear that many of the managerial officials do not know all of their tasks and responsibilities that they are required to do by law during a crisis. It further becomes clear that many of the managerial officials that play a role during crisis control do not recognize the other roles and parties involved and the tasks and responsibilities required to be performed by them. As a result they often do not know with who they can and often should collaborate and communicate.

The second problem is regarding information management. It becomes clear that many of the managerial officials do not know where to obtain the necessary information and do not know what information is available to them. This indicates that there is a need to bring oversight in the way information should be shared among different teams and individuals of the crisis organization.



The cause for the two above mentioned problems can for a great part be sought in the training and practice for the managerial functionaries, or the lack thereof. The third recognized problem is therefore a lack in training.

***Sq3: What solutions have been proposed to solve these problems?***

The problems that were recognized are gathered from rapports dating back to 2000. Therefore the solutions that have been proposed by the government to solve the problems are the same as discussed when answering the first sub question, e.g. the safety chain and law safety regions.

***Sq4: What modeling techniques are at this moment state of the art and are candidates to be used to model the disaster control domain? Sq6: How can existing modeling techniques be used to model and analyze these problems and solutions?***

To answer this sub-question this research focused on techniques used for enterprise architecture (EA) modeling and business process (BP) modeling. The main reason for researching EA modeling techniques is that such techniques have been successfully applied in complex business organizations suggesting that these techniques also have advantages for the public order and safety domain because of the similarities between business organizations and crisis organizations. Similar to business organizations, crisis organizations are characterized by structural complexity (many loosely coupled units), hierarchal relationships (many levels of command and reporting) and procedural rules (many constraints on how to act or operate). The advantages EA has on organizational alignment makes that the involvement of relevant people of the crisis organization is stimulated, which positively affects the knowledge of the presence of other roles and other partners. The information availability benefits may help to communicate between regions, and make that there is more uniformity about the interpretation of laws.

The reason for researching BP modeling techniques is that processes play a major role in crisis organizations. BP modeling and analysis is used in various administrative companies to optimize their processes, suggesting that BP modeling techniques are also useful for the public order and safety domain to provide the required oversight and insight for solving the identified problems.

Although there are several techniques that may be suitable, we selected the ArchiMate modeling language as one suitable technique for modeling the public order and safety domain. The choice for ArchiMate is motivated by the fact that its tool is easily adaptable to fit the need of the intended user. Since the public order and safety domain differs from administrative organizations in regard to terminology that is used, functions, and structures, the modeling solution asks for adjustments. Therefore the modeling language ArchiMate is used in this thesis.

***Sq5. What modeling techniques are currently used in the domain of disaster control?***

It seems that not many modeling techniques are used or have been used in the public order and safety domain. This became apparent after researching various documents on official government sites regarding the public order and safety domain. In total there were three types of models found: an information model for the public order and safety, administrative network maps and the tool BiZZdesign's Architect. The latter was used to model the actor process relations on an operational level. There were no records of the models actually being used in the domain, with the exception of the administrative

network maps. However, these administrative network maps are not clear and extensive. All three models do not provide a solution for the recognized problems.

***Sq7: What extensions/improvements are necessary for current modeling techniques to correctly model the public order and safety domain?***

After reviewing the ArchiMate language we found that many of the concepts and relations of ArchiMate fulfill in the requirements that were recognized. However, since the ArchiMate language is business oriented and the terminology and relations used are not directly applicable to the public order and safety domain, we defined a new modeling language based on ArchiMate. This language is called the public order and safety modeling language (POSML). A conceptual model was created to describe the concepts and relations. Most concepts that were created a specialization of existing ArchiMate concepts. The creation of the POSML is done by specialization of the concepts that are important for the domain in relation to existing concepts in ArchiMate. This ensures that the original functionality of the language stays intact while expanding it to fit the needs of the domain. Also several visual changes were made. This enabled the possibilities for showing views of a model using visually different shapes than the original rectangles with text in the middle. In this case the choice of presenting the models not in the traditional way of squares and arrows is because the intended end users, i.e. the stakeholders, are not used to work with models and might be opposed in advance to work with models. The shapes for the concepts are chosen in a way that it is easy for users to see what is meant.

***Sq8: Is the developed conceptual model suitable in terms of used concepts?***

The requirements were discovered using various documents of the public order and safety domain and through a series of brainstorm sessions. According to the experts, the concepts and relationships that were implemented offers sufficient possibilities to model the public order and safety domain. According to the semi-structured interviews that were held among experts in various fields related to the public order and safety, i.e. scenario developers, virtual training game developers, domain experts, trainers, and modeling experts, the concepts were overall rightfully defined. Only a couple of minor suggestions for adjustment resulted from the interviews. However the interviews did recognize the need for testing the proposed extension by actually using it in the domain.

***Sq9: Do these models help to...***

***...better understand the problems?***

***...analyze the proposed solutions and support?***

***...solve the recognized problems?***

The interviewees overall concluded that the abilities that the models offer would most likely contribute to the creation of a scenario, the development of a training game, and a better understanding of the tasks and roles involved in crisis control by the managerial functionaries.

***Mq1: How can existing modeling techniques be used to model the domain of public order and safety so as to improve oversight and insight in the domain, and to help professionals with creating, providing, and receive training at the managerial level regarding disasters and crisis?***

The realized conceptual model based on ArchiMate offers a modeling language that allows people in the domain to capture the complexity of the crisis organization into models. Examples of how this can be done were shown to experts in interviews performed during this thesis. According to the experts, models can improve oversight and insight in the domain and can also help create, provide and receive training. However in order to fully understand the usefulness of the models in the domain and to create a conceptual model that captures all relevant aspects, the models should be tested by using them in the domain. In conclusion, with the use of models in the domain, it should be possible to help solve the problems the domain has with oversight and insight of the organization and the problems regarding the training of the managerial level personnel.

## 9.2 LIMITATIONS

### Number of interviews

Five interviews were held during this research for validation of the rightfulness and usefulness of the model. The validation would however be stronger if the opinions of more experts were collected. Now only one expert per stakeholder was interviewed. When more experts per stakeholder would have been interviewed there would be more opinions and thus a better evaluation of the proposed solution. Also the opinions of people working or used to work in managerial teams during a crisis are not collected. The reason for not interviewing these experts is that the proposed solution does not provide a fully accurate example yet. Still we believe that our validation is not seriously limited by the fact that we have not explicitly targeted opinions of managers who have worked in actual crises. This because the people normally working in crisis teams represent two stakeholders: the managerial functionaries, and the trainees.

### Type of validation

Despite the fact that semi-structured interviews were used as a validation method, the conceptual model and the use thereof asks for a more elaborate and practical validation. The conceptual model and the models that can be created with POSML need to be tested in a real or simulated setting. An example of how this can be done can be found in Chapter 8.

### Scope

The proposed solution is implemented using the ArchiMate language and the supporting tool Architect. Even though there were clear reasons for doing so, the possibilities of using other techniques are not extensively researched. Therefore it might be that other techniques prove to be more suited or offer more functionality than Architect does and thus provide a better solution for the recognized problems.

### 9.3 RECOMMENDATIONS & FUTURE WORK

Two hypotheses were proposed in the beginning of this thesis. These hypotheses were used to test if the problems that occurred in the domain of public order and safety could be supported or solved by using modeling techniques. ArchiMate was used to provide such a modeling technique. The ArchiMate language was used as bases for a newly defined modeling language. The requirements for the new language were recognized during the TOKO project, resulting in the Public Order and Safety Modeling Language (POSML). Based on the research it cannot sufficiently be concluded that the hypotheses are proven valid.

The first hypothesis, *Models can help trainers, training developers and trainees in creating, providing and receive training*, is supported by various experts after semi-structured interviews were held. However, more research is required to conclusively state that models help training developers and trainees in creating, providing and receive training.

The second hypothesis, *Models can help professionals at a managerial level in the public order and safety domain to gain more insight and oversight in the crisis organization*, is also supported by various experts after semi-structured interview were held. However, also for the second hypothesis, more research is required to validate that the proposed solution helps professionals in managerial teams of the public order and safety to gain more insight and oversight.

The results of this thesis are promising. However, in order to conclude that the proposed solution will do what was stated in the hypotheses, the proposed solution should be validated in a practical manner. Therefore the recommendations are to stay in contact with the domain experts and validate the proposed solution further. The way to execute such a practical validation is described in Chapter 8 of this thesis. This should provide the information needed to more thoroughly validate the hypotheses and show if the use of models can help solve the problems that the domain has regarding oversight and insight in the crisis organization and in regard to training of managerial level personnel.

## REFERENCES

- [1] IMV. "TOKO TrainingsOmgeving voor grootschalig multidisciplinair KetenOptreden." Private communication, unpublished.
- [2] BiZZdesign. "BiZZdesign.com," Internet: <http://www.bizzdesign.com> [April 5, 2012].
- [3] BiZZdesign. "BiZZdesign positioned as a Leader in Gartner Magic Quadrant for Enterprise Architecture 2011," Internet: <http://zwww.bizzdesign.com/home-mainmenu-1/news/173-positioned-leader-gartner> [Feb 28, 2012].
- [4] Public Order and Safety Inspectorate. Internet: <http://www.ioov.nl/onderwerpen/rampenbestrijding> [Feb. 28, 2012].
- [5] National crisis centrum. "Bestuurlijke netwerkkaarten crisisbeheersing 2011." Internet: <http://www.nationaalcrisiscentrum.nl/document/bestuurlijke-netwerkkaarten-crisisbeheersing-2011> [Sept. 11, 2012].
- [6] nvbr0. "Wie is nu de baas van de brandweer?" Internet: [Video file] [http://www.youtube.com/watch?v=Fe6zPusNMK0&feature=youtube\\_gdata\\_player&noredirect=1](http://www.youtube.com/watch?v=Fe6zPusNMK0&feature=youtube_gdata_player&noredirect=1) [Sept. 11, 2012].
- [7] Central government. "wet-veiligheidsregio-s-wvr" Internet: <http://www.rijksoverheid.nl/onderwerpen/veiligheid-regionaal/wet-veiligheidsregio-s-wvr> 2011, [Sept. 9, 2012].
- [8] Public Order and Safety Inspectorate. "Brand Chemie-Pack Moerdijk." Internet: <http://www.ioov.nl/>, 2011, [Sept. 11, 2012].
- [9] A. Osterwalder, Y. Pigneur and C.L. Tucci. "Clarifying business models: origins, present, and future of the concept." Communications of AIS, volume 15, 2005.
- [10] A. Osterwalder, and Y Pigneur "Business model generation: a handbook for visionaries, game changers, and challengers," Modderman Drukwerk, Amsterdam, 2010.
- [11] M. Lankhorst. "Enterprise Architecture at work: Modelling, communication and analysis." Springer-Verslag, Berlin, Heidelberg, 2005.
- [12] M.J. Tolsma and H.M. Franken, "Business Process Management(BPM) : procesinzicht en procesverbetering," BiZZdesign B.V., 2005.
- [13] K Peffers, T. Tuunanen, M.A. Rothenberger, and S. Chatterjee. "A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems, 3(3), 2008, 45-77.
- [14] A.R. Hevner, S.T. March and J. Park. "Design research in information systems research," MIS Quarterly, 28, 1, 2004, pp.75-105.
- [15] NIFV. "NIFV.nl" Internet: <http://www.nifv.nl> [Sept, 11, 2012].

- [16] Foundation Netherlands Alert. "Wat is een ramp," Internet: <http://www.nederlandalert.nl/crisis/wat%20isz%20een%20ramp.doc/> [Feb 28, 2012].
- [17] Minister of the Interior and Kingdom Relations "Wet Veiligheidsregio's." Internet: [http://www.st-ab.nl/wetten/1146\\_Wet\\_veiligheidsregio's.htm](http://www.st-ab.nl/wetten/1146_Wet_veiligheidsregio's.htm) 2010 [March, 11, 2012].
- [18] Rijksoverheid. "Nationaal Handboek Crisisbesluitvorming" Internet: <http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2009/11/23/nationaal-handboek-crisisbesluitvorming.html>, Nov. 23, 2009 [Sept, 11, 2012].
- [19] Ingenieurs/Adviesbureau SAVE & Adviesbureau Van Dijke "Leidraad Maatramp" Internet: <http://www.regionaalcrisisplan.nl/bestanden/file58615186.pdf>, [Sept. 11, 2012].
- [20] Ministry of the Interior and Kingdom Relations. "Informatie Vitale Sectoren" Internet: <http://www.rijksoverheid.nl/documenten-en-publicaties/brochures/2010/06/23/informatie-vitale-sectoren.html> July, 06, 2010 [Sept. 11, 2012].
- [21] Rijksoverheid. "Nationaal Handboek Crisisbesluitvorming" Internet: <http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2009/11/23/nationaal-handboek-crisisbesluitvorming.html>, Nov. 23, 2009 [Sept, 11, 2012].
- [22] Minister of the Interior and Kingdom Relations "Wet Veiligheidsregio's." Internet: [http://www.st-ab.nl/wetten/1146\\_Wet\\_veiligheidsregio's.htm](http://www.st-ab.nl/wetten/1146_Wet_veiligheidsregio's.htm) 2010 [March, 11, 2012].
- [23] Rijksoverheid. "Wet veiligheidsregio's (WVR)," Internet: <http://www.rijksoverheid.nl/onderwerpen/veiligheid-regionaal/wet-veiligheidsregio-s-wvr>, [Sept, 11, 2012].
- [24] Rijksoverheid. "Veiligheidsregio," Internet: <http://www.rijksoverheid.nl/onderwerpen/veiligheid-regionaal/veiligheidsregio> [Sept. 11, 2012].
- [25] Rijksoverheid. "Who does what in a disaster" Internet: <http://www.government.nl/issues/crisis-national-security-and-terrorism/who-does-what-in-a-disaster>, [Sept. 11, 2012].
- [26] NIFV. "Animaties Handboek Voorbereiding Rampenbestrijding" Internet: [http://www.nifv.nl/upload/155967\\_668\\_1244704659084-overzicht1.swf](http://www.nifv.nl/upload/155967_668_1244704659084-overzicht1.swf), [Sept. 11, 2012].
- [27] Ministerie van veiligheid en Justitie. "Bevindingen nationale risicobeoordeling 2007" Internet: <http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2008/05/30/bevindingenrapportage-nationale-risicobeoordeling.html>, May, 30, 2008, [Sept. 11, 2012].
- [28] "Risicokaart" Internet: <http://risicokaart.nl/> [Sept. 11, 2012].

- [29] “Nadere toelichting referentie kader GRIP” Internet: <http://www.infopuntveiligheid.nl/Publicatie/DossierItem/12/193/nadere-toelichting--referentiekader-grip.html>, June, 2008, [Sept. 11, 2012].
- [30] GHOR IJssel-Vecht. “Gecoördineerde Regionale Incidentbestrijdings Procedure (GRIP),” Internet: <http://www.nifv.nl/web/show/id=93512/contentid=580>, [Sept. 11, 2012].
- [31] “Nationaal crisiscentrum” Internet: <http://www.nationaalcrisiscentrum.nl/document/nationaal-crisiscentrum>, [Sept. 11, 2012].
- [32] Commissie Oosting. “De vuurwerkramp Eindrapport” Feb. 28, 2001.
- [33] Commissie Berghuijs. “De toekomst van de rampenbestrijding en het risicomangement” Internet: <https://dloket.enschede.nl/loketburgers/pdc/9588>, Nov. 03, 2000, [Sept, 11, 2012].
- [34] “Brand Chemie-Pack ontstaan door gasbrander” Internet: <http://www.brandveilig.com/nieuws/brand-chemie-pack-ontstaan-door-gasbrander-33020>, July, 04, 2011, [Sept. 11, 2012].
- [35] Onderzoeksraad Voor Veiligheid. Conclusie rapport OVV Chemie-Pack” Internet: [http://content1a.omroep.nl/687f6432b6b85d98e23e43e513a2de5e/4f13e00e/nos/docs/150112\\_eindconclusies\\_chemiepack.pdf](http://content1a.omroep.nl/687f6432b6b85d98e23e43e513a2de5e/4f13e00e/nos/docs/150112_eindconclusies_chemiepack.pdf), [Sept. 11, 2012].
- [36] IOOV. “Brand Chemie-Pack Moerdijk.” Internet: [https://www.nationaalcrisiscentrum.nl/sites/risicoencrisis.sandbox.tdclighthouse.com/files/assets/documents/20110823\\_2011-200036262b%20Beleidsreactie%20op%20het%20Inspectierapport%20OVV%20rapport.pdf](https://www.nationaalcrisiscentrum.nl/sites/risicoencrisis.sandbox.tdclighthouse.com/files/assets/documents/20110823_2011-200036262b%20Beleidsreactie%20op%20het%20Inspectierapport%20OVV%20rapport.pdf) Aug. 24, 2011[Sept. 11, 2012].
- [37] VRR. “Evaluatierapport VRR Chemie-Pack Moerdijk” Internet: <http://www.handhavingsportaal.nl/publicaties/evaluatierapport-vrr-chemie-pack-moerdijk> [Sept. 11, 2012].
- [38] “Besluit veiligheidsregio’s” Internet: [http://www.st-ab.nl/wettennr07/1146-001\\_Besluit\\_veiligheidsregio's.htm](http://www.st-ab.nl/wettennr07/1146-001_Besluit_veiligheidsregio's.htm), July, 21, 2012 [Sept. 11, 2012].
- [39] Instituut voor Veiligheids- en Crisismanagement (COT). “Op de grens van werkelijkheid: Observatierapportage oefening Bonfire” Internet: <http://www.oefeningbonfire.nl/> [Sept. 11, 2012].
- [40] Capgemini, TNO and Berenschot “Evaluatie oefening Voyager” Internet: <http://www.infopuntveiligheid.nl/Publicatie/DossierItem/16/1617/evaluatie-oefening-voyager.html> 2008 [Sept. 11, 2012].
- [41] FLIWAS. “Evaluatie HIS/FLIWAS tijdens Waterproef” Internet: <http://www.burgemeesters.nl/node/2157> [Sept. 11, 2012].
- [42] T. Tamm, P.B. Seddon, G.Shanks and P Reynolds, “How Does Enterprise Architecture Add Value to Organisations?” Communications of the Association for Information Systems: Vol. 28, Article 10. 2011. Available at: <http://aisel.aisnet.org/cais/vol28/iss1/10>.

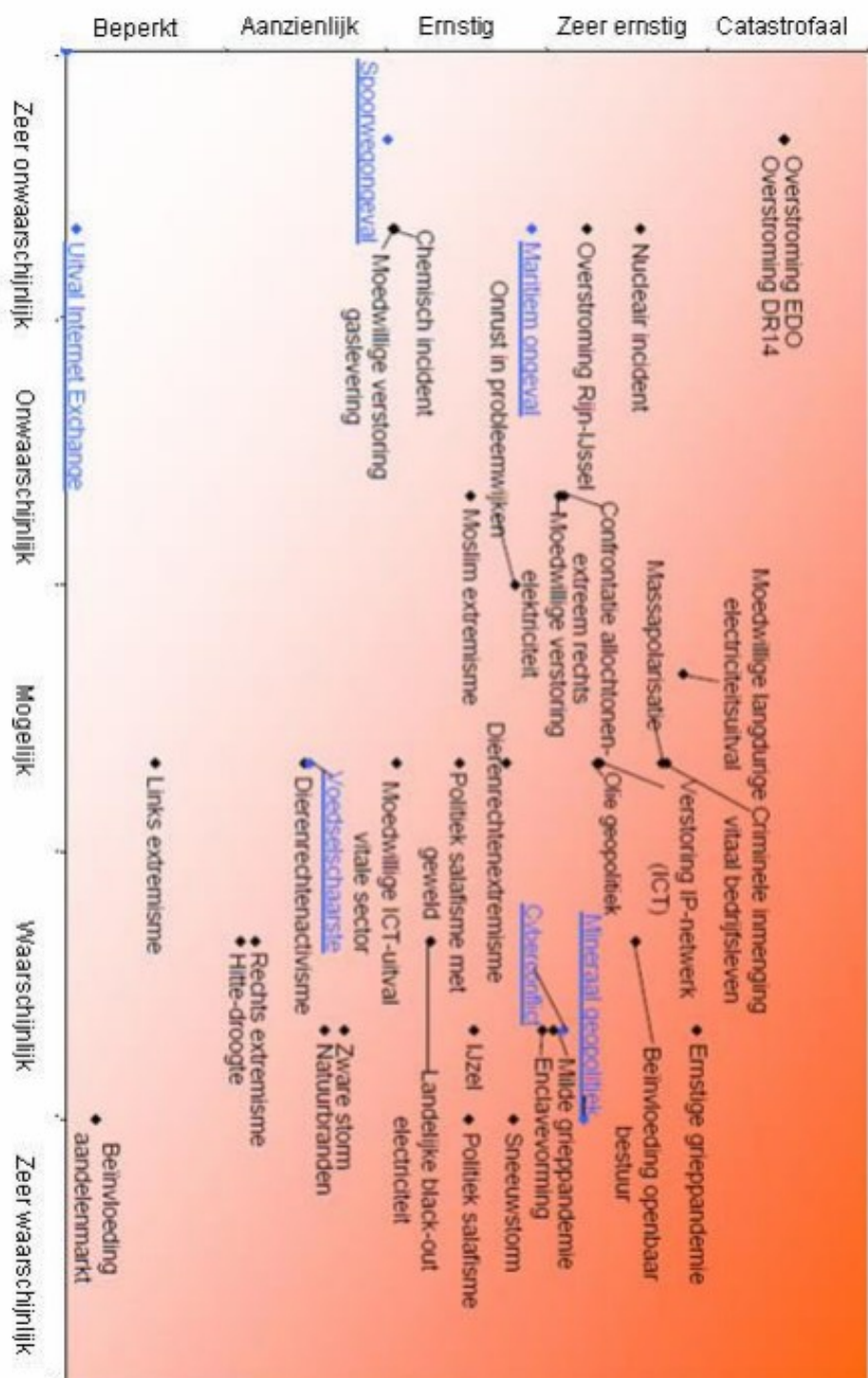
- [43] Gartner inc. "Enterprise Architecture (EA)" Internet <http://www.gartner.com/it-glossary/enterprise-architecture-ea/> [Sept. 11, 2012].
- [44] The Open group. "ArchiMate 2.0 specification" Van Haren publishing, Zaltbommel, 2012.
- [45] M. Lankhorst. "Enterprise Architecture at work: Modelling, communication and analysis." Springer-Verslag, Berlin, Heidelberg, 2005.
- [46] F. Goethals. "An Overview of Enterprise Architecture Framework Deliverables" DTEW Research Report 0570, 2005, pp:1-16.
- [47] L. Urbaczewski, S. Mrdalj. "A comparison of enterprise Architecture Frameworks" Volume VII, No. 2, Issues in Information Systems, 2006.
- [48] The Open Group. "The Open Group Architecture Framework" Internet: <http://pubs.opengroup.org/architecture/togaf8-doc/arch/>, [Sept. 11, 2012].
- [49] It Management Group. "TOGAF best practice" Internet: <http://www.togaf.biz/togaf-best-practice/>, [Sept. 11, 2012].
- [50] The Open Group. "TOGAF Version 9.1, an Open group Standard" Internet: <http://pubs.opengroup.org/architecture/togaf9-doc/arch/> [Sept. 11, 2012]
- [51] J. Polgreen. "Using TOGAF® to Develop and Implement Enterprise Architecture in Government - U.S. Federal Agencies as Example" Internet: [http://www.architecting-the-enterprise.com/enterprise\\_architecture/articles/using\\_togaf\\_to\\_develop\\_and\\_impliment\\_enterprise\\_architecture\\_in\\_government\\_-\\_u.s.\\_federal\\_agencies\\_as\\_example.php](http://www.architecting-the-enterprise.com/enterprise_architecture/articles/using_togaf_to_develop_and_impliment_enterprise_architecture_in_government_-_u.s._federal_agencies_as_example.php) [Sept. 11, 2012]
- [52] The Open group. "ArchiMate 2.0 specification" Van Haren publishing, Zaltbommel, 2012.
- [53] The Open Group. "Archimate 1.0 Specification," Van Haren publishing, Zaltbommel, 2009.
- [54] The open group. "ArchiMate® 1.0 Specification" Internet: [http://www.opengroup.org/archimate/doc/ts\\_archimate/chap3.html](http://www.opengroup.org/archimate/doc/ts_archimate/chap3.html) [Sept. 11, 2012]
- [55] The open group. "ArchiMate® 2.0 Specification" Internet: <http://pubs.opengroup.org/architecture/archimate2-doc/appendixA.html> [Sept. 11, 2012]
- [56] M. Hause. "The unified profile for DoDAF/MODAF (UPDM) Enabling Systems of Susystems on Many Levels." Systems conference, 2010, San Diego, CA, 4<sup>th</sup> annual IEEE, 2010, pp 426-431.
- [57] A.S. Algamdhi. "Evaluating Defence Architecture Frameworks for C4I System Using Analytic Hierarchy Process." Journal of computer science 5 (12), 2009 pp 1075-1081.
- [58] OMG. "What is UML?" Internet [http://www.omg.org/gettingstarted/what\\_is\\_uml.htm](http://www.omg.org/gettingstarted/what_is_uml.htm), [Sept. 11, 2012].



- [59] A. I. Holub. "Allen Holub's UML quick reference." Internet: <http://www.holub.com/goodies/uml/>, Sept. 26, 2011 [Sept. 11, 2012].
- [60] "UML 2 Class Diagrams" Internet: <http://www.agilemodeling.com/artifacts/classDiagram.htm> [Sept. 11, 2012].
- [61] The open group. "ArchiMate® 1.0 Specification" Internet: [http://www.opengroup.org/archimate/doc/ts\\_archimate/chap3.html](http://www.opengroup.org/archimate/doc/ts_archimate/chap3.html) [Sept. 11, 2012].
- [62] W.M.P. van der Aalst, A.H.M. ter Hofstede, and M. Weske. "Business Process Management: A Survey" Lecture Notes in Computer Science, 2003, Volume 2678/2003.
- [63] Object management group OMG. "Business Process Model and Notation (BPMN) Version 2.0." Internet: <http://www.omg.org/spec/BPMN/2.0/> Jan. 2011 [Sept. 11, 2012].
- [64] Object management group OMG. "BPMN 2.0 by Example" Internet: <http://www.omg.org/spec/BPMN/20100601/10-06-02.pdf>, June, 2010 [Sept. 11, 2012]
- [65] M. Dumas, M.P. Wil, van der Aalst, A. H. M. ter Hofstede. "Process-Aware information systems: Bridging People and Software through Process Technology." Oct. 7, 2005.
- [66] BiZZdesign, "Bizzdesign.com" Internet: <http://www.bizzdesign.com/tools/bizzdesigner>, [Sept. 11, 2012]
- [67] Geonovum. "Informatiemodel openbare orde en veiligheid." Internet: <http://www.geonovum.nl/geostandaarden/imoov>, [Sept. 11, 2012]
- [68] Provinces Flevoland, Gelderland, Noord-Holland and Overijssel. "Bestuurlijke netwerk kaarten crisisbeheersing" Internet: <http://www.infopuntveiligheid.nl/DossierItem/38/856/bestuurlijke-netwerkkaarten-crisisbeheersing.html>, 2012, [Sept. 11, 2012].
- [69] "Netcentrisch werken bij Crisisplein" Internet: <http://www.crisisplein.nl/>, [Sept. 11, 2012]
- [70] Nederlands instituut fysieke veiliheid. "Infopunt veiligheid." Internet: <http://www.infopuntveiligheid.nl/Publicatie/SitePages/HomePage.aspx>, [Sept. 11, 2012]
- [71] S. Robertson. "Requirements trawling: techniques for discovering requirements" International Journal of Human-Computer Studies, Volume 55, Issue 4, October 2001, Pages 405–421.
- [72] Novay. "Novey.nl" Internet: <http://www.novay.nl/over-novay/8>, [Sept.11, 2012].
- [73] TNO, "TNO.nl" Internet: <http://www.TNO.nl>, [Sept. 11, 2012].
- [74] M.L. Smith and J. Erwin. "Role & Responsibility Charting (RACI)" 2007

- [75] D.L. Moody. "The "Physics" of Notations: Towards a Scientific Basis for Constructing Visual Notations in Software Engineering." IEEE transactions on software engineering, vol. 35, no. 5, November-December 2009.
- [76] E.R. Babbie. "The practice of social research." Wadsworth Publishing, 10 edition, 2007.
- [77] J.W. Creswell. "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches." Sage Publications, Inc, 3rd edition, July, 15, 2008
- [78] N.K. Denzin and Y. S. Lincoln. "The handbook of qualitative research." Sage Publications, Inc, 3rd edition April, 8, 2005.
- [79] Martin van den Berg, Remco Blom, Leo van Brandwijk. "Wegwijzer voor methoden bij enterprise-architectuur." Van Haren publishing, 1st edition, 2009.

## APPENDIX A.: RISK DIAGRAM



## APPENDIX B.: OVERVIEW OF PROBLEMS DURING CRISIS CONTROL

The following table gives a quick overview of the important problems recognized regarding the three large disasters discussed in chapter three

<b>Firework disaster Enschede</b>	
<b>Keywords</b>	<b>Points of neglect</b>
<i>Communication</i>	There were two COPI's, where there should be only one.
	Insufficient leadership from COPI in the first hour
<i>Lack of knowledge task</i>	Unclear communication paths, it is unclear for many people involved who to communicate and collaborate with.
	Failing information connections, resulting in an incomplete overall picture of the disaster.
<i>Compliance</i>	No clear command structure, when multiple municipalities are involved.
	Unclear roles and tasks for the people involved at a managerial level.
	Often unclear who is in charge.
<b>Chemie-pack Moerdijk</b>	
<b>Keywords</b>	<b>Points of neglect</b>
<i>Communication</i>	No collaboration on how to communicate to the citizens
	Difficulty in comprehension and in time communication between parties involved due to lack of knowledge of each other's tasks and responsibilities in the new safety regions law and due to the switching of roles during the disaster.
	Poor accessibility of the municipality of Moerdijk and 2 involved safety regions due to unawareness of the impact of the fire which resulted in a poor and slow scaling process of the disaster.
	Bad communication to the citizens due to the lack of knowledge of measuring data gained from "Milieu Accidents Service"
<i>Lack of knowledge task</i>	The law safety regions does not consider the managerial alignment in case of an above region disaster when there is not a national crisis.
	Problems with GRIP-scaling, not correctly scaled, uncertainty about who should initiate further scaling after GRIP 2.
<i>Compliance</i>	Each other tasks and responsibilities are unclear.
	Too much switching in roles of the parties involved.

	<p>Uncertainty of the national role of parties like the NCC, ICCB, and V&amp;J. The role of these parties often changed.</p> <p>Uncertainty about the role of the “managerial support team environmental accidents”, this despite the collaboration agreement. This can be explained due to the above regional nature of the disaster which resulted in the uncertainty about who had responsibility.</p>
<b>Volendam, Bonfire, Voyager, Waterproof</b>	
<b>Keywords</b>	<b>Points of neglect</b>
<i>Information-provision / Communication</i>	- Low information exchange, not enough initiative to provide or gain a uniform crisis picture (Bonfire)
	- Poor alignment and communication (Volendam)
	- Limited direct contact between the key officials from MBT and the municipal staff regarding coordination of the activities on national and municipal level. (Bonfire)
	- Information exchange between the different departments and the BZK was limited. (Bonfire)
	- In the early phases of the exercise the information available on a national level, reached the regional and local level delayed and fragmented. (Bonfire)
	- Lack of interoperability made that the information and communication sources used did not work well in sharing the information uniformly. (Voyager)
	- The information exchange does insufficient take place and not in time.
	- Alignment between departments on a national level should be improved. Decisions were not formulated in a clear and structured way this influenced the way other organization coped with the decisions.
<i>Lack of knowledge task</i>	- There was confusion about what decision structure that needed to be followed. (Bonfire)
	- Wide task perception, which resulted on a focus mainly on the most necessary actions instead of also the long term decisions by the MBT. (Bonfire)
	- Responsibilities of every department are known within that department, however the responsibilities of the other departments are not always known.
<i>Compliance</i>	- The information exchange between the national and local level did not function as it was determined in the crisis plans.(Bonfire)
	- Managerial officers should keep the urgency of the organizational

	preparation for floods high by keeping plans up to date and as complete as possible, keep their experience and expertise (education and training) and most importantly by practicing with exercises.
--	--

## APPENDIX C.: INTERVIEW PROTOCOL

### **Goal**

The goal of the interview is to check the validity of the conceptual model and the usefulness of the proposed use of the this conceptual model in practice, i.e. the views. The interviewees will be people of the TOKO project, since they are experts in the domain of public order and safety, training, scenario development and modeling. Therefore an additional advantage is that the people of this target group are also the intended users. To summarize the interviews are used to reach two validation goals:

1. Validation of the concepts and relations of the conceptual model
2. Validation of the usefulness and suitability of the solution

### **Approach**

The interviews will all start with a presentation where the main ideas and concepts are presented. A document is shared with the interviewee that lists the concepts that are present in the conceptual model. From there the subjects of the interview are discussed and are made clear to the interviewee:

- Validation of the used concepts and relationships
  - Are the concepts and relationships rightfully defined?
  - Are there concepts or relationships missing?
- Usefulness of the models to the interviewee
  - Are the presented views useful for the interviewee?
  - Can the models help the interviewees in their work in the public order and safety domain?

### **Interview Questions**

The following questions are used as guidance during the interview. Since the interview is semi structured there will be room to elaborate on each question. For the interviewee this means he can share opinions and arguments that do not directly relate to the question. For the interviewer this means that for each question there is room for follow-up questions. The interview questions are based on the scientific articles that are used in this thesis so far. The interview also contains questions regarding the work method of the different interviewees, this is done to also review the conceptual model.

### **Concepts used in the conceptual model**

The following questions are used to discuss the in chapter five described concepts and relations of the conceptual model. The conceptual concept itself is not shown to all the interviewees, since the conceptual model is most likely too technical in regard to the background of the interviewee. Instead the examples that are given in the end of chapter five are shown and used to discuss the semantics of the models and thus come to a validation of the concepts and relations used.

### **Used concepts and relations**

- Are the proposed concepts correct?
- Do you use the proposed terminology when working in the public order and safety domain?
- Are the concepts rightfully defined?
- Are there concepts missing, do the interviewee require more concepts in the (meta-) model?
- Are the relations between the concepts selected correct?
- Are there relations between concepts missing, do you require more or different relations in the (meta-) model?

### **Use of the models general**

The following questions are used to discuss the multiple views that are shown in the pre-interview presentation. By asking general question about the views two goals are achieved. First the usefulness for models in general discussed, providing validation for the intended goal. Second the interviewee can provide other possibilities for views.

- Could the proposed views be useful for you?
- Could the proposed views be useful for people having a managerial function in the public order and safety domain?
- Are the chosen viewpoints relevant?
- Are there viewpoints missing?
- Do you see other possibilities for views?

### **Use of models specific**

The following questions are interviewee specific. Using the specific examples of the presentation, discussed in chapter five, as basis for these question ensures that the usefulness of stakeholder specific views can be elaborately discussed.

#### **Questions trainee/domain expert specific, using figure 59 & 60 as example.**

- Does the proposed example provide more oversight and insight?
- Could these views help to better recognize your tasks?
- Could these views help to better recognize roles in the crisis organization?
- Could these views help during a training or crisis?

#### **Questions trainer specific, using figure 62 as example.**

- Does the example bring more clarity about communication/information/collaboration?
- Could this view help you give a training?

#### **Questions scenario developer specific, using figure 63 as example.**

- Are there conditions for a scenario?
- Does the scenario contain (one of) the mentioned terms?



- Do you use standard triggers/events that should evoke the “player” to take action?  
Or.
- Do you use specific questions asking for actions or decisions?
- Do you have a specific task or decision in mind when you create a trigger/event?
- Do you consider learning goals as basis for the scenario and triggers/events?
- Do you consider competences as basis for the scenario and triggers/events?
- Is it possible to make standard blocks/sections of scenario’s which can be combined to form a whole scenario?
- Do you get limitations or specific demands from the instrument developer?

**Questions training game developer specific, using figure 63 as example**

- How much do you adjust the scenario to make it suitable for a virtual game?
- Could the view help communicating with a scenario developer?
- Could the view help to gain more insight in the scenario?
- Does such a view help you to make a training game?

## APPENDIX D.: SUMMARY'S OF THE INTERVIEWS

The summaries of the interviews are listed in this appendix. Because the interviews were in Dutch the summary of the interview will also be in Dutch.

### ***Interview Paul Porskamp***

#### **Data interviewee:**

Name: Paul Porskamp

Organization: T-Xchange

Function: Lead Architect at T-Xchange

#### **Algemeen**

Gedurende het interview ging het ook voornamelijk over het proces van serious game-development. Binnen T-Xchange worden 2 soorten projecten onderscheiden: onderzoeksprojecten en commerciële projecten. Tijdens het interview wordt er regelmatig de burgermeestersgame als voorbeeld gebruikt. De burgermeestersgame is een serious game waarin burgermeesters een scenario voorgeschoteld krijgen en kunnen oefenen met het nemen van beslissingen over enkele realistische dilemma's. Het proces dat werd doorlopen tijdens het creëren van de burgermeestersgame komt dan ook overeen met het proces dan doorlopen dient te worden met het maken van een game ter behoeven van het trainen van het bestuurlijk niveau tijdens een crisis of ramp.

#### **Samenvatting**

Om tot de opbouw van een serious game te komen volgt een project de nodige cyclische stappen met betrekking tot het maken van een scenario waarin verschillende dilemma's centraal staan. Deze stappen worden altijd met een domein expert doorlopen. Modellen kunnen in dit proces helpen door middel van het verstrekken van de nodige informatie om een zogenaamde nulde-orde-expert te worden met betrekking tot het onderwerp waarvoor de serious game is bedoeld. Deze modellen samen met een berg aan documenten kunnen omschreven worden als high-visibility modellen, informatie en een overschat aan informatie die zullen moeten worden teruggebracht tot low-visibility. Dit wil zeggen samen met een domein expert en onderwijskundigen de wereld die beschreven wordt in de high-visibility modellen sterk te versimpelen. Dit gebeurt altijd door middel van "ambacht" en het samen overleggen en ingrijpen van mensen. Modellen alleen zijn hier niet afdoende. Het heeft verder ook geen zin om op voorhand modellen van het hele domein te maken omdat het domein te snel verandert om informatie naar juistheid in modellen vast te leggen. De modellen zouden echter wel waarde toe kunnen voegen om samen met een expert to low visibility te komen. Dit komt omdat de modellen een duidelijk beeld geven van taken, rollen en competenties, welke makkelijker te lezen zijn dan de functieprofielen die gebruikt worden binnen TOKO. Al is het wel zo dat dit niet noodzakelijk is en nog steeds gedaan kan worden met documenten en de domein expert.

Een andere toepassing voor modellen en de getoonde manier van modelleren (met rollen taken en competenties) is als een soort vakantievelingen site. In het geval van trainingen voor het openbare orde en veiligheidsdomein kan er dan getoond worden welke competenties er met welke leerinstrumenten/scenario's getraind kan worden. Als dit zou

werken, zou het eventueel ook de andere kant op kunnen, dus dat er games worden gemaakt bij de vraag naar training voor bepaalde competenties.

Toegevoegde waarde van modellen voor Paul persoonlijk zit hem in een stakeholder analyse en het in beeld brengen van het onderwijs model. Stakeholder analyse voor het bij elkaar brengen van vraag en aanbod zijde van aan de ene kant trainingbehoevende in het domein en aan de andere kant aanbieders van virtuele trainingen. Het onderwijs model gaat vooral over de vraag: wie zitten er allemaal in het domein, en hoe krijgen die mensen onderwijs?

## **Conclusie**

Paul is sceptisch over het gebruik van modellen met betrekking tot game-development in dit geval. Het biedt een goede visualisatie van nodige informatie dat als input kan dienen voor het maken van een game. Echter is het zo dat deze modellen samen met een expert terug moeten worden gebracht naar een versimpeling, zodat alleen een versimpeling overblijft die gegamificeert kan worden. Een view waarin competenties gekoppeld worden aan leerdoelen en actoren kunnen nuttig zijn voor het selecteren van trainingen. Het wordt dan echter wel een soort van vakantieveiling, waarbij je je af kan vragen of dat de toepassing moet zijn van modellen.

## **Interview Leo Ceelen**

### **Data interviewee:**

Name: Leo Ceelen

Organization: NIFV

Function: Senior advisor trainer at Netherlands Institute for Safety NIFV

### **Algemeen**

Het interview met Leo Ceelen geeft weer hoe een trainer aankijkt tegen mogelijkheden van modellen. Leo heeft veel ervaring met het geven van onderwijs binnen het openbare orde en veiligheidsdomein. Door zijn ervaring kan hij worden gezien als expert op het gebied van trainingen geven binnen het domein.

### **Samenvatting**

Combinatie leerdoel en type scenario. Bij een leerdoel heb je dus bepaalde competenties en ga je bepaalde gedragingen verbinden en die moeten getriggerd worden vanuit events. Die events zijn gebaseerd op bepaalde scenario's en die scenario's kunnen ook helemaal vooraan in het leerdoel gegeven zijn. Voor een leider ROT geldt dat zij 80% van de gewone incidenten moet af kunnen handelen. Dus dan moet je iets zeggen wat gewone incidenten zijn en wat zij dan minimaal moeten kennen en kunnen, van de scenario's. Het loshalen van de competenties als apart concept is "helemaal goed". Leo is echter op zoek naar een combinatie, ik wil de competenties hebben, maar ik zie dat in de werkelijkheid dat mensen ook beoordeeld worden, niet op de competenties maar op de mate waarin ze het inhoudelijk vakgebied beheersen. Een brand bijvoorbeeld kan op verschillende manieren ontstaan en verschillende manieren ontwikkeld en bestreden worden. Het is dus belangrijk dat een brandweerman een 7 tal verschillende brandscenario's heeft getraind. Daarom is het belangrijk dat competenties getraind worden in verschillende omstandigheden, in verschillende scenario's. Het systeem moet dit ook duidelijk maken.

Dus als iemand steeds een type brandscenario doet, herhaalt hij zichzelf en leert hij niks meer, want hij heeft het al een aantal keer gedaan. Dit is een discussie in Nederland die al even duurt. Over de jaren is dit verandert omdat bijvoorbeeld leerlingen die naar de universiteit gingen, in mindere maten hadden geleerd hoe zij moesten onderzoeken en hadden minder geleerd hoe ze moesten leren. De competenties zijn dominant geworden, boven de leerinhoud. De competenties gaan weer ondergeschikt worden aan de leerinhoud. Ik wil de competenties geleerd hebben, maar ook getoond zijn in een bepaald scenario met een bepaald crisistype. "Het eerste getoonde voorbeeld vind ik op zichzelf heel goed, het geeft helderheid. Dit wil je zien en hierop kan je ook feedback geven. De 6 kenmerken van een scenario blijven dominant."

Het is heel functioneel, om te zien welke taken een bepaalde rol heeft, bij welke rol. Als je dus een boompje maakt is heel erg nuttig en heb ik plezier van.

Na het laten zien van figuur 69: "dit is heel goed. Buiten het feit dat er een paar rollen niet in het voorbeeld genoemd worden, iets wat heel belangrijk is voor de volledigheid vooral als je het aan andere laat zien, is het een duidelijke manier van weergeven."

Modellen als communicatie manier. De trainer krijgt inzicht in welke competenties moeten worden aangesproken en doet dit doormiddel van events. "Binnenkort ga ik mensen examineren, het gaat dan om een ROT team. Tegen deze mensen heb ik gezegd: Dit zijn de competenties waarop je gaat faciliteren, dus je moet zorgen dat je gedrag uitlokt op deze onderdelen. Dit zeg ik tegen de rollen spelers en tegen de examinatoren. De examinatoren kijken naar de competenties waarop ze moeten beoordelen. De vervolgvraag die ze stellen is "welke scenario's heb ik dan allemaal?" Het antwoord kan dan zijn: een GRIP 2 in een bepaald scenario. Maar eerst wil ik het kader vaststellen van wat er geleerd moet worden en welke competenties. Ik zeg dus ook heel duidelijk welk gedrag er getoond dient te worden." Illustratie: Voor een training heb ik een scenario gehad met een stroomuitval 2 dagen voor kerst. In een stad met een mooie kerstmarkt. In het centrum + 1 wijk gaat de stroom eruit. Dus ik wil dan inderdaad zoals het voorbeeld zien welk gedrag moet men laten zien en wat zijn de trigger, dat is gewoon netjes. Je zou inderdaad de gemaakte modellen kunnen gebruiken tijdens een training om te doorlopen hoe een training gaat verlopen of is verlopen. Vaak weten de opdrachtgevers aan het NIFV niet precies wat de competenties en gedragingen zijn waarop tijdens een examen of training op gelet moet worden, ze weten niet precies wat ze getraind willen hebben. Dit schema(voorbeeld) is een volstrekt helder schema. Een ander soort stakeholder is de organisator. Bijvoorbeeld de hoofden van elke veiligheidsregio, van opleiding en oefenen. Zij krijgen grote budgetten (miljoenen) om vervolgens om te zetten naar trainingen, om te zorgen dat mensen vakbekwaam worden en vakbekwaam blijven. Zij laten scenario's maken als ze niet voor handen zijn die 2 tot 3 ton kosten. Hij geeft dan ruim een jaar van te voren aan wat voor trainingsscenario hij wil hebben, met welke teams, externe organisaties en welke prestaties er dan geleverd dienen te worden.

Expliciet, het is echt bruikbaar, je moet hem ook op dezelfde manier uitschrijven op teamcompetenties. De interactie tussen de teams ook voorbeeld matig uitwerken, dus voorbeeldmatig weergeven hoe de informatie posities bepaald worden of bevel lijn tussen teams. Verder veel meer voorbeelden uitwerken, als je naar de scenario boom kijkt zul je daar categorie 1 en 2 voorbeeld matig uit moeten werken. Hiermee win je acceptatie in Nederland als het sterk genoeg is. Ook de samenhang van de verschillende teams en organisatie bij die categorieën.

Het is helaas zo in Nederland dat er geen 1-op-1 relatie is tussen de functies(rollen) en de competenties. Dit komt omdat verschillende commissies zich hierover hebben uitgesproken. Wat betreft TOKO, er wordt een scenario gemaakt op dit moment. Dit scenario zou je kunnen gebruiken om de modellen te toetsen. Zet het scenario om in modellen, toets de werking van de modellen en kijk of je nu makkelijker tot een virtuele game kan komen. Als dit goed uitgewerkt wordt kun je dit tegen mensen aanhouden die daadwerkelijk in een crisis management team zitten, of hebben gezeten en zodoende bruikbare feedback krijgen.

“Verder wil ik de voorbeelden die tijdens de presentatie voorbij kwamen, wil ik graag gaan gebruiken bij Rijkswaterstaat. Bij Rijkswaterstaat moet ik allemaal oefeningen gaan geven over procedures aan te leren. Hiervoor heb ik een instrument nodig zonder woorden, precies dit instrument wat er nu voorbij kwam. Hartstikke handig. Je krijgt dan een hele andere context voor gebruik.”

Gebruik van modellen tijdens een training zijn voor ervaren ROT leden waarschijnlijk niet van toepassing. Echter kunnen de door Leo genoemde harkjes (een rol met zijn taken visueel weergegeven) ongelooflijk handig zijn voor onervaren of jonge leden die zijn of haar taken of dat van collega's onvoldoende paraat hebben. “Bijvoorbeeld hadden we ooit iemand als leider OT die zijn taken, en taken van een ROT in het algemeen niet duidelijk in zijn hoofd had zitten, in dat geval zijn modellen uitermate nuttig. Voor de teamleden en externe adviseurs die van buiten komen is het ook handig. Er zijn dus zo al 3 partijen die er plezier van zouden kunnen hebben.”

“Verantwoordelijkheden worden hoger in het beleid steeds belangrijker, het is belangrijk deze ook terug te laten komen in de modellen. Ik reken teams namelijk ongelooflijk hard af op het niet nemen van beslissingen. En op het niet communiceren van beslissingen.”

## **Conclusie**

Leo is enthousiast over de getoonde modellen. Hij zou graag een concept gedragingen zien in het model, omdat hij vooral het getoonde gedrag van mensen beoordeelt tijdens trainingen. Verder is Leo van mening dat bij het gebruik van voorbeelden, het belangrijk is zo volledig mogelijk te zijn. Mensen binnen het domein vallen namelijk snel over fouten en zullen bij een volledig model eerder geneigd zijn het positieve van het gebruik van modellen in te zien. Over de competenties zegt Leo dat hij zoekt naar een combinatie van competenties en type scenario dat is gevolgd. Mogelijk zal er nog een verdere specificatie worden gegeven aan het concept competentie. Echter is het zo dat in Nederland nergens duidelijk gespecificeerd is hoe om te gaan met competenties. De competenties zijn bepaald en bestempeld als belangrijk voor elke type rol door een aparte commissie. Dit is een andere commissie die over de taken van verschillende rollen binnen de verschillende teams beslissingen neemt. Hierdoor zal het moeilijk zijn daadwerkelijk competenties aan taken te koppelen. Echter word er wel altijd gekeken naar het gedrag dat een trainee vertoont tijdens een training als reactie op een event. Verder wordt er door Leo aangegeven dat hij de getoonde modellen in de toekomst graag zou gebruiken als hulpmiddel tijdens trainingen. Hij was voor een specifieke training met Rijkswaterstaat al opzoek naar een manier om uitleg te geven 'zonder woorden' de getoonde modellen lijkt daar een uitstekende optie voor. Conclusie is dan ook dat modellen waarde kunnen toevoegen binnen het domein van openbare orde en veiligheid. Als eerste bij functionarissen werkzaam in het domein. In dit geval gaat het over het visueel duidelijk kunnen tonen van taken van rollen en samenwerking tussen rollen. En als tweede voor

trainers en trainees om de gebeurtenissen aan te geven die tijdens een training voorbij gaan komen, of die voorbij zijn gekomen.

## **Interview Klaas Groot**

### **Data interviewee:**

Name: Klaas Groot

Organization: Thalix

Function: Software Engineer at Thales Nederland B.V

### **Algemeen**

Dit interview is gedaan om te kijken hoe de voorbeeld views een virtuele training ontwikkelaar kan helpen in het maken van een trainingsspel. Dit interview is geen face to face interview, maar een groeps gesprek met meerdere mensen (allemaal gerelateerd aan TOKO). Het is echter wel zo dat de vragen aan Klaas dezelfde zijn als opgesteld in het protocol. Het doel van het gesprek is ook om de voorbeelden te tonen en hier feedback op te krijgen, dit maakt het vergelijkbaar met het houden van een semistructureel face-to-face interview.

### **Samenvatting**

Hoe zouden we dit nou aan kunnen pakken, want op dit moment deze modellen gebruiken om een scenario te maken gaat niet lukken, daar hebben we de kennis niet voor en wordt het dus nooit een goede crisis. Omgekeerd zou wel kunnen we zouden een bestaand scenario kunnen pakken en deze in de modellen kunnen gieten om te kijken of de het ook kan werken wat we nu beogen. We kunnen dan zien of modellen werken voor deze ideeën. Daar zou het wel kunnen helpen dat we de belangrijke punten van een scenario ook daadwerkelijk aan kunnen wijzen, de belangrijke events, met de taken en competenties.

*Begrijp ik dan goed dat het ook een goed communicatie middel kan zijn bijvoorbeeld voor tussen de trainer en de trainee?*

Ja, meestal gebeurt dat ook en daar zou dit bij kunnen helpen.

*Zien je de bruikbaarheid van modellen, kunnen ze nuttig voor je zijn bijvoorbeeld voor het maken van een spel?*

Klaas is op dit moment bezig om een trainingsspel te ontwikkelen genaamd I-play. Tijdens het interview komt naar voren dat er veel raakvlakken zijn met de getoonde modellen. Zodoende lijken op het eerste gezicht de concepten met de relaties juist gedefinieerd.

“Er is een scenario op dit moment waarin bepaalde events beschreven zijn en welke spelers er in zitten. Dus eigenlijk zijn events in deze, de berichten/de informatie die een speler krijgt, vaak gaat dit natuurlijk over een crisis aspect. Ik als spelletje maker, ga er van uit dat een scenario beschrijft wat er gaat gebeuren en wat er op een speler af moet komen, dus welke informatie deze krijgt. Als er een scenario is met verschillende teams krijgen zij allemaal informatie krijgen en daarop actie ondernemen, waardoor ze op een gegeven moment allemaal een informatie bron van elkaar worden. Ik ga er min of meer vanuit dat er zo een scenario, dus met berichten en informatie voor elke speler, wordt aangeleverd. Het enige is het leeraspect dat duidelijker naar voren moet komen.”

Je zou als trainer de getoonde modellen kunnen gebruiken om mee te lopen tijdens een training, dus dat je ziet welke events er aan zitten te komen en weet wanneer je waar op moet letten als het gaat om taken, competenties, en gedragingen.

Als de modellen dieper worden uitgewerkt wordt het voor Klaas heel interessant. "Want als je een scenario aangeleverd krijgt staan er alleen de gebeurtenissen en informatie in. Het is aan ons om dan uit te zoeken wat gaan de verschillende rollen nou doen. Met wie gaan ze contact zoeken en dienen ze samen te werken? Waar halen ze informatie vandaan en welke taken worden nu uitgevoerd? In een scenario zal dit niet staan dus modellen zijn hier een welkome toevoeging."

## **Conclusie**

Naar aanleiding van dit interview, deze meeting, is er afgesproken maandelijks een meeting te organiseren met Klaas om het (halve) scenario wat er is aangeleverd door TOKO te gebruiken als case en invulling te geven aan de modellen. Dit heeft tot doel om te kijken of de modellen daadwerkelijk helpen om het scenario weer te geven en of deze representatie helpt om tot een game te komen. Klaas was gematigd enthousiast over de getoonde voorbeelden. De concepten blijken goed en zijn ook de begrippen waar Klaas over praat als het gaat over het maken van een game en over het domein. De eerder gestuurde en dieper uitgewerkte modellen vond hij heel erg nuttig als informatie input voor het maken van games. Hieruit blijkt dat er wel degelijk vraag is naar een manier om informatie te bieden over het domein en modellen lijken een goede manier om hier invulling aan te geven. Echter moet na verdere (gebruikers) validatie blijken of dit of de getoonde manier gaat kan gebeuren of dat er nog aanpassingen nodig zijn. Hier kan echter pas antwoord op komen als het pad van is doorlopen voor het maken van een game met behulp van modellen.

## ***Interview/Group session Dick Quartel, Lex Heerink***

### **Data interviewee:**

Name: Dick Quartel, Lex Heerink

Organization: BiZZdesign, Novay

Function: Senior research consultant, senior advisor

### **Algemeen**

Dick en Lex zijn beiden experts op het gebied van modellen. Zij weten beiden heel goed wat de mogelijkheden zijn van modellen en gemodelleerd werken. Ze hebben beiden veel gezien wat er mogelijk is voor bedrijven als het gaat de waarde die modellen kunnen toevoegen. Het interview gaat dan ook voornamelijk over het gebruikte conceptueel model, de voorbeelden uit de presentatie en de mogelijkheden die ze beide zien van de modellen binnen het domein.

### **Samenvatting**

Modellen worden gebruikt in een ander domain, organisaties worden complex net als hun omgeving en modellen helpen om inzicht te krijgen en helpen gestructureerd bedrijven te veranderen. Het OOV domein kan worden gezien als een grote complexe organisatie. Een

modelmatige manier moet daar zeker voordelen kunnen bieden. Je hoort ook geluiden, vooral binnen TOKO, dat modellen interessant zijn en zeker nuttig kunnen zijn in het domein. Maar de slag naar concreet toepassen en uitproberen lijkt lastig te maken omdat je dan mensen in het domein nodig hebt die dat willen doen. De getoonde voorbeelden zijn een goed begin om te gaan kijken of de verschillende partners in TOKO het nut inzien van dit soort modellen.

Je zou ook nog aan bouwblokken kunnen denken, als het gaat om een scenario. Dat je voor het maken van een scenario je stukjes van al gemaakte scenario's gebruikt. Om te reageren op het interview met Paul. De link van events met taken is ambacht aldus Paul. In principe begint alles met ambacht natuurlijk, maar op het moment dat je meer ondersteuning gaat bieden en de gemaakte modellen in bibliotheken gaat vastleggen dan word het steeds minder een ambacht. Een model zegt niet hoe je een spel moet maken, maar legt bepaalde dingen vast. En maakt het inzichtelijker als het goed is. Dat is met ontwerpen ook, in feite vraagt dat ook om ambacht, en niet voor niks komen er steeds meer technieken, kennis, en patronen beschikbaar, zodat je daar bij kan ondersteunen en de ambacht minder word.

Domein kennis die je inzichtelijk maakt, en het feit dat je makkelijker scenario's kan maken op een gegeven moment, zou het domein aan moeten spreken.

*In hoeverre is een model nuttiger dan een database?*

De verschillende getoonde view geven al aan wat voordeel van een model is. Je zou het kunnen uitbreiden met een hoop taken etc., dan ontstaat er uiteindelijk een heel groot model van. De kracht van dit model nu in plaats van een database, is dat je er nu een database uit kan afleiden. Het model is aanleiding geweest in dat geval om dat te kunnen doen. Het begint ermee dit inzichtelijk te krijgen, door middel van een model. Met databases kun je nauwelijks inzicht geven aan mensen in het domein, met modellen kan dit wel. Een model laat in meerdere mate de samenhang van alle concepten zien, op deze manier verduidelijk je dingen en word het een stuk inzichtelijker.

Het makkelijk van modellen is ook dat je visueel heel veel duidelijk kan maken, zo kan je met behulp van het gebruik van kleuren duidelijk het verschil aangeven tussen bijvoorbeeld een oude en een nieuwe situatie.

Met modellen kunnen we nu ook makkelijk analyses maken, we kunnen kijken wat de verschillen zijn tussen situaties. We kunnen verschillende documenten in modellen opnemen, hierna kunnen er door de tool "berekeningen" worden gedaan. Zo kunnen er verschillen getoond worden die eerder nog niet zichtbaar waren.

Bij het toevoegen van verschillende attributen waardoor je een complexer model krijgt, komt ook meteen de kracht van modellen naar voren. Je kunt nu namelijk automatisch "filteren" of bepaalde voorwaarden.

Belangrijk is voor jullie nu te laten zien dat modellen nuttig kunnen zijn binnen het domein. Deze voorbeelden zijn daar erg geschikt voor. Ook al mist er nog domein kennis, modellen zullen uiteindelijk aantonen dat er inderdaad kennis mist, of informatie, of dat er gaten bestaan in de brei van documenten.

## **Conclusie**

Het is duidelijk dat beide heren model experts zijn en veel ervaring hebben in het werken met modellen. Er kwamen een aantal duidelijke argumenten naar voren tijdens het interview waaruit blijkt dat modellen veel waarde toe zouden kunnen voegen in het



domein. De kracht van modellen zit hem in het feit dat het complexiteit kan verminderen. Het beeld dat nu bestaat en voorkomt uit Zoals

## **Interview**

### **Data interviewee:**

Name: Richelle van Rijn

Organization: TNO

Function: Research assistant

### **Algemeen**

Richelle van Rijn is al enkele jaren bij TNO, en heeft zich gespecialiseerd in het openbare orde en veiligheid domein. Binnen TOKO is zij dan ook als domein expert aanwezig en onder andere ook bezig met het schrijven van een scenario. Buiten de algemene kennis van het domein heeft Richelle met haar achtergrond in het geven van onderwijs en training binnen het domein. Richelle kan met haar expertise goed beoordelen of de concepten en relaties correct en volledig zijn, alsmede haar mening geven over het gebruik van de voorgestelde modellen.

### **Samenvatting**

Tijdens het uitleggen van de stakeholders voor het interview, geeft Richelle al snel aan dat vooral het in kaart brengen van informatie bronnen en informatie stromen erg belangrijk zal zijn m.b.t. het modeleren. De reden hiervoor is dat dit op nu vaak niet duidelijk is voor alle betrokken teams en rollen tijdens het bestrijden van crisis. De reden dat het belangrijk is om dit in kaart te brengen is zodat teams weten wie de informatie nodig heeft of nog zit te wachten op de informatie die een specifiek team in haar bezit heeft. Het inzichtelijk maken van de gehele crisisbestrijding keten is hierbij ook zeer belangrijk. Men weet dan met wie ze samen moeten werken, maar ook bij wie de informatie behoeften liggen.

Tijdens het uitleggen van de concepten werd duidelijk dat de koppeling tussen competentie en leerdoel een lastige is. Dit komt omdat een leerdoel een sterkere link heeft met het type van een scenario dat getraind dient te worden en niet zozeer de competenties. De competenties zijn in deze te specifiek. Competenties komen pas kijken op het moment dat er getraind is en gekeken wordt of de competenties binnen een bepaalde training voldoende zijn getoond door een trainee. Wat betreft de doelstellingen voor een training zijn er 8 manieren/aspecten om tot dergelijk doelstellingen te komen, er kan 1 van die aspecten een doelstelling bepaald worden maar ook op alle acht. Richelle zou eerder iets van een verwijzing maken omdat competenties een behoorlijk specifiek niveau is om op te beoordelen waarbij competenties ongeacht het type incident beoefend kunnen worden. Je zou het dan kunnen koppelen aan een tweede doelstelling, een inhoudsgerichte doelstelling. Bijvoorbeeld het nemen van een doelstelling als “het oefenen van een hoogwater situatie” gecombineerd met “het goed leren samenwerken tussen teams”.

Bij het eerste voorbeeld wordt het leerdoel wederom behandeld en geeft Richelle aan dat het leerdoel vooral op het niveau van taken wordt beschreven en niet zozeer op het niveau van competenties. Het leerdoel is vaak uitgebreider dan dat het alleen competenties te leren competenties beschrijft. De meeste oefeningen bestaan uit één generiek hoofddoel en meerdere specifiekere doelstellingen, meestal een stuk of vier. Dus als je modellen wilt gebruiken voor matching zou je het op die manier moeten koppelen. Samenvattend zou je

in het eerste voorbeeld het leerdoel moeten koppelen aan de taken en die op zijn beurt koppelen aan de competenties die daarvoor nodig zijn.

Bij het tweede voorbeeld zal de focus moeten liggen op de taken, verantwoordelijkheden en bevoegdheden van de verschillende rollen en teams binnen een crisis organisatie. De gedachte en het idee achter dit voorbeeld zijn goed, maar wat je vaak ziet is dat de moeilijkheden vooral liggen bij de teams die niet weten hoe de verantwoordelijkheden zicht over de crisisketen verplaatsen als er wordt opgeschaald bijvoorbeeld. Daarom zou je dit beter kunnen visualiseren als de hele keten. Dit is dus wel iets waar heel veel behoefte ligt, vooral als je het meer insteekt op de algemene keten.

Het derde voorbeeld wordt heel positief ontvangen door Richelle. Er is weinig kritiek op en het is een goede manier om inzicht te krijgen hoe er samengewerkt dient te worden op welk moment.

Het vierde voorbeeld zou nuttig kunnen zijn voor de evaluator en niet zozeer de trainer. Het is belangrijk onderscheid te maken tussen deze twee stakeholders. De trainer richt meer op wat er bereikt moet worden met een training en of dit in lijn ligt met de leerdoelen. De evaluator krijgt vaak documenten aan de hand waarvan hij achteraf zijn evaluatie doet over een training. In deze documenten staan duidelijke tijdlijnen aan de hand waarvan hij kan zien welke events er wanneer voorbij komen en ook kan zien waar hij op moet letten qua gedrag en taakuitvoering wat betreft de rollen. Hierop worden aantekeningen gemaakt. Het enige verschil wat er is tussen de documenten en het getoonde voorbeeld is een tijdslijn of tijdseenheid. Dat is dan ook een aanpassing die ik zou maken als het gaat om het voorbeeld, voeg er een tijdslijn aan toe. Op het niveau van evaluator komen competenties steeds meer ter sprake. De evaluator beoordeelt op het moment van training wel op vooraf bepaalde competenties en is in dit voorbeeld dus een juiste keuze gemaakt om competenties te koppelen aan de events.

Het laatste getoonde voorbeeld is lijkt sprekend op het eerste voorbeeld. Echter is het zo dat het beoogde doel in deze, de communicatie tussen scenariomaker en gameontwikkelaar, hiermee niet wordt ondersteunt. Het maken van een trainingssgame gebaseerd op een scenario is een uitgebreid iteratief proces. Het is een hele belangrijke vertaalslag om te komen van een scenario tot een game. Het gaat dan ook voornamelijk om berichten die belangrijk zijn tijdens een training. Als het nog geen bestaande game is heb je een hoop aantal andere mensen ook nodig, zoals bijvoorbeeld onderwijsdeskundigen. Dat zou ik dus ook niet met behulp van modellen doen.

## **Conclusie**

Concluderend is Richelle positief over de mogelijkheden die modellen kunnen bieden. Een kleine aanpassing is dan wel nodig om de focus meer te leggen op de communicatie, informatieoverdracht en samenwerking tussen teams. Het algemene idee is duidelijk en kan nuttig zijn binnen het domein. Enige punt waar nog naar gekeken dient te worden is de matching tussen het leerdoel en training. Dit gebeurt in de voorbeelden voornamelijk door middel van competenties, maar dit is niet de manier waarop het op dit moment in het domein gebeurt.