

# An approach for identifying the strategic focus areas of a domain

Applied in the Flood Control Domain in the Netherlands



## Combining

## DEMO and CBM

Design and  
Engineering  
Methodology  
for Organizations

Component  
Business  
Model



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By  
KhaledTokhi  
Student number: 1111647  
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Thesis Committee:

Chair: Prof. Dr. Ir. Jan L.G. Dietz, Faculty EEMCS, TU Delft  
University supervisor: Prof. Dr. ir. Jan L.G. Dietz, Faculty EEMCS, TU Delft  
Company supervisor: IBM Certified IT Architect Bram Havers  
Committee Member: Dr.ir. Jan J. van den Berg, Faculty TBM, TU Delft  
Committee Member: Ir. H.J.A.M. Geers, Faculty EEMCS, TU Delft

## Abstract

The threat of flooding is of great concern to many countries and significant resources are spent to deal with this threat. A better understanding of the motivation of organizations responsible for flood control and their reasons for selecting certain modes and targets can help improve the decisions to allocate resources in the fight against flooding. The fundamental question addressed in this paper is: “How to identify the strategic capabilities of the flood control domain?”

This question is addressed through engineering of a new generic approach which utilizes two methodologies of enterprise engineering discipline namely DEMO and CBM in a hybrid fashion. This approach is realized in the form of the SBCI-method which is an approach that allows the representation of the organization of the enterprise in terms of its essential building blocks, in which it is possible to identify those building blocks which are of strategic relevance.

We take the view that preferences for actions are based on their values and beliefs. An important missing piece in our knowledge of these preferences is an understanding of their relevance and position in the construction of the system that is suppose to realize them. This paper uses a novel approach to determine these values and beliefs by determining them in full isolation from the systems that need to realize them, by using principles from enterprise engineering discipline and policy analysis paradigm. Hence instead of interviewing decision makers and stakeholders within organizations, as would be normal in policy analysis, we extract the objectives by examining the policy documents. And structure them in terms of strategic, business, and means objectives. These objectives are then mapped to the building blocks of the domain that is supposed to be responsible for their successful realization.

This information is useful for understanding flood domain organizations motivations, intent, and likely actions, as well as for developing solutions to counter the threat of flooding.

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# 1 Introduction

This document serves as a Master Thesis (IN500IA) project report, which is executed in IBM's Global Center of Excellence for Water Management. The center is established in Amsterdam, the Netherlands in response to the growing concerns over the climate change and its potential impact on low-lying coastal regions. The center is drawing on IBM's consulting, technology and research expertise to help their public sector clients worldwide to develop enhanced prediction and protection systems for low-lying coastal areas and river deltas.

IBM Global Center of Excellence for Water Management focuses on providing the Dutch government and disaster control agencies with improved forecasting and prediction models. It will draw upon IBM expertise in smart sensors and utilize serious gaming technology and 3D internet skills to create realistic modeling and simulations. In the course of time, the center is focusing in providing additional innovative solutions relating to water management, which will be available to IBM clients worldwide.

## 1.1 *Related work*

This project builds upon the work of B.D.Mongula which she did as part of her master thesis project in IBM Global Center of Excellence for Water Management in August 2009. In her work she used the DEMO methodology to generate enterprise ontology of flood control domain in the Netherlands.

These ontological models for the domain allowed IBM's Center of Excellence for Water Management to understand and visualize the enormous complexity that exists in the flood control domain as a result of the multi-actor setting of the domain.

## 1.2 *Research aim*

The aim of this project is to the engineering of an approach or a method which when applied would allow the identification and specification of the strategic focus points of the whole flood control domain in the Netherlands. This aim would have the effect of creating a shared understanding among the actors and stakeholders of the domain about the of the strategic focus points in the domain. For achieving the aim of the project, theories and methodologies present in the field of enterprise engineering is utilized.

## 1.3 *Research relevance*

This research project is of relevance to both societal and scientific worlds with each having their own gains. Societal world is here represented by IBM and water agencies while the scientific world is the Technical Informatics faculty of TU-Delft.

### **IBM**

- Summarize & quantify domain complexity and identify the strategic focus areas.
- Analyze the effectiveness of their innovative solutions relevant to the strategic focus areas of domain, independent of the operational & implementation level details.
- Understand the position and connection of CBM methodology of IBM with respect to DEMO.

### **Water agencies**

- Visualize their organizations position and contribution in the domain with respect to other involved actors for the purpose of improving the inter/intra organizational cooperation.
- Evaluate their organizational performance in terms of strategic objectives set out for the whole of the domain.
- A shared understanding and conceptualization of the strategic focus areas of the domain.

#### **TU-Delft**

- Level of compatibility between DEMO(Design & Engineering Methodology for Organizations) as language developed in the academic environment and CBM of IBM build in business environment
- Obtain a proof of concept on the effectiveness of ontological models and enterprise engineering discipline in aiding the evaluation and reverse-standardization of organizational operations and construction.

#### **1.4 Intended audiences**

This thesis work aims at addressing two different communities of audiences. The first one is the water managers whose organizations are directly involved in the flood control operations. The second is the IT architects and consultants.

Primarily both of the mentioned communities of audiences benefit from this work, because they get a realization of what are the essential building blocks of the domain and they get to know where the strategic focus areas of the domain lay.

Secondly to water managers the models of the domain created in this project, offers them global outline or a helicopter view of the domain, in which they will be to locate and observe their own, and other organizations position and contribution to the domain, and under where the strategic areas of the domain lay.

As for the IT architects and consultants who are not subject matter experts of the flood domain, these models in effect compensates to some degree for their lack of subject matter expertise when they are fresh starters in the domain. Additionally this group also obtains a new method of modeling with which they can augment their toolbox of methods and techniques that they use in their profession.

#### **1.5 Document outline**

This document contains eight chapters in total. This chapter includes the introduction in which a brief description of the main aspects of the research is given. The important chapters of which include chapter 4,5 and 6 are provided with a recapitulation section in which the most important points discussed and presented in that chapter gets comes back in summarized fashion. This style is adopted to ease the readability and avoid a lengthy conclusion section.

Chapter 2 includes the information relating to the set-up of the research. In it a description of the main steps through which the main goal of the project got formulated, along with the research scope, organization and process is given. Chapter 3 includes a contextual conceptualization of the practical world (i.e. flood control domain in the Netherlands) for which this research is conducted. The content of this chapter allows the reader of the document to understand the environment and the context around which the research is conducted. Chapter 4 chapter describes a theoretical inventorization of the modeling methodologies and their underlying theories along which this research is organized which includes enterprise engineering as the discipline and DEMO and CBM as two of its modeling methodologies. Chapter 5 describes the how inventorization of the methodologies in chapter 4 got led to the realization of new modeling approach. Chapter 6 describes the practical application of this modeling approach in the flood control domain. Chapter 7 describes an evaluation of the main objectives of the project. Finally, chapter 8 wraps up the document by a conclusion and recommendation for future research.



## 2 Research Design

This chapter is intended to describe the process through which the main goal of the project is formulated. The first step in formulation of the project goal was the forming of the problem statement. Based on the problem statement, a general research question is derived which gets further delimited into concrete sub-questions. The answers to each one of the research sub-questions will eventually form the individual objectives of the project. Generalization of these individual objectives forms the main project goal. The project goal gets further sharpened through specification of the project scope. Figure 1 illustrates the design process of this research, which is going to be explained step by step in the coming paragraphs of this chapter.

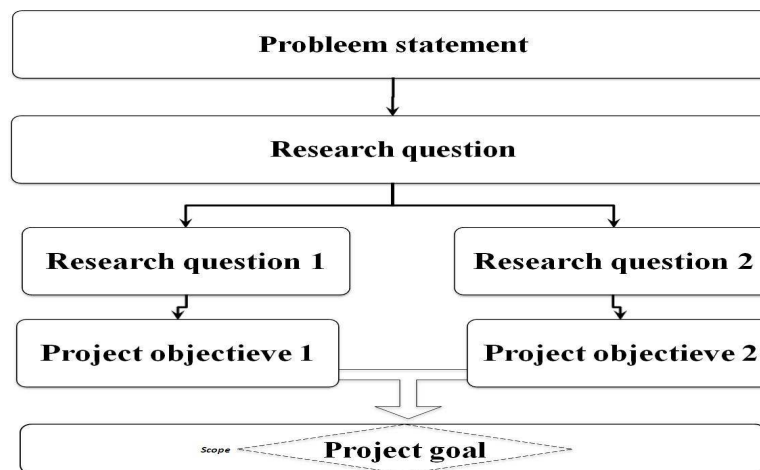


Figure 1 Research design

### 2.1 Problem statement

The constant fight of the Dutch against the water for which they are worldwide famous is largely a consequence of her geographic location, being located in the delta of three major rivers (Rhine, Meuse, and Scheldt). This implies that flood risks for them are enormous. It is therefore vital that they consider their coastal and river defenses vital and keep them at the highest quality, which are being constantly improved using new solutions. But, since the Hurricane Katrina in 2005 the Dutch have come to the realization that they cannot continue to rely for their safety against water only through protective physical measures like building stronger defenses, higher dikes and increased drainage to withstand the flood prone threats. Instead, a far more sustainable approach in flood control domains is needed to safeguard the natural functioning of their wetlands, coasts, rivers and delta's.

Sustainable flood management does not only include physical and technical *prevention* and *protection* measures but as well, a variety of long- and short term strategic measures, which will bring about an effective *response* and *recovery* measures against flood events. It applies in particular to extreme events, where the force of water exceeds the strength of precautionary measures and brings into the flood scene disaster management actors such as medical, fire and other relief agencies. This means that *operational management* of activities before, during and after a flood event is of crucial importance for the reduction of the flood hazards. Recent extreme flood events, like those of Central European floods of 2010[2] revealed that a far more comprehensive approach which quantifies the activities of all flood control actors with respect to each other in combination with technological innovations is the only way forward towards an effective flood risk management.

The presence of such issues raises a number of critical questions such as: Does the water managers realize implications for their tasks and objectives in the face of climate change related flooding? If so, are they able to react in a timely and adequately manner? What constitute the organizational and institutional barriers to implement a certain proposed flood control schemes?

Based on the presence the above mentioned questions, the problem statement of this research can be stated as follows: One of the tools which can directly contribute towards a comprehensive approach in combating the flooding in a timely and adequately manner is availability of models which will allow water managers to rapidly and concisely, identify the strategically important focus areas of the flood control domain, independent of organizational boundaries.

## **2.2 Research question**

The interest of the IBM's Global Centre for Excellence for Water Management in this project lies in understanding the areas where strategic focus is required or needed by the water agencies. This is part of IBM's global interest in acquiring a comprehensive, structured and strategic understanding of the flood control domain, so that they can provide innovative solutions for improving the overall structure of the underlying business processes within the flood control domain.

Based on the problem statement and the interest of IBM as the *problem owner*, the following research question is formulated:

*“How to identify, specifies and represent the strategic focus areas (at enterprise level) in the flood control domain in the Netherlands?”*

Since the above thesis question is too abstract to derive a concrete project goal from it, it is delineated into the following discrete sub-questions:

- 1 What are the essential building blocks of the flood control domain?
- 2 Among these essential building blocks, which one of them is of the relevance to the strategic objectives of the flood control domain?

The above mentioned sub-questions hold the constraint of being independent of the organizational boundaries of the domain actors and the implementation details.

## **2.3 Project objective**

From the above thesis questions, the following objective got proclaimed for this project:

*“The engineering of an approach, which allows identification, specification and representation of the strategic focus areas of the flood control domain in the Netherlands.”*

This objective would constitute the followings sub-objectives which would lead to providing answers for the first and second sub-questions of the research:

1. Engineering of a generic approach, which allows identification, specification and representation of essential building blocks of a domain; such that the strategic focus areas of a domain can be specified in terms of these building blocks.
2. The application of this approach in the flood control domain in the Netherlands with the aim of understanding where the strategic focus areas lay.

The above mentioned objectives when achieved would form a comprehensive framework, which firstly allows the water managers to view and understand the strategic focus points in flood control domain and align their own organizations strategy to that of the whole domain. Secondly it allows IBM to understand the focus areas of its current and potential future clients in the water domain.

## 2.4 *Design requirements*

The successful realization of innovative initiatives in the form of a successful enterprise is a rather complex issue. According to numerous studies it is proven that less than ten percent of strategic initiatives are implemented successfully, which is a very alarming figure. The reason for this low figure is the wrong or absence of a concrete design requirements. Therefore, before starting the design process which is the nature of this project, it is imperative to inventorize the tools and methodologies, which will aid in design process. This steps is considered to be one of most crucial one in the system development process.

For this project in order to meet the objectives of the project which is a componentized representation (at enterprise level) of a domain it is required to specify the properties of the models which will ultimately aid in fulfillment of these objectives. The design criteria for the models of this research work are:

- Functional design, which represents the behavioral models of the system in terms of input and output.
- Constructional design, which represents the constructional model of the system in terms of relationships of system elements with each other.

These two aspects together will form a complete overview of the domain at highest abstraction level possible for the purpose of this research. The discipline and methodologies used to obtain the required models are explained in chapter 4.

## 2.5 *Project scope*

The objective of the project was primarily established in accordance with the interest of the problem owner which for this project is IBM's Global Center of Excellence for Water Management. These in turn steer the overall direction project process.

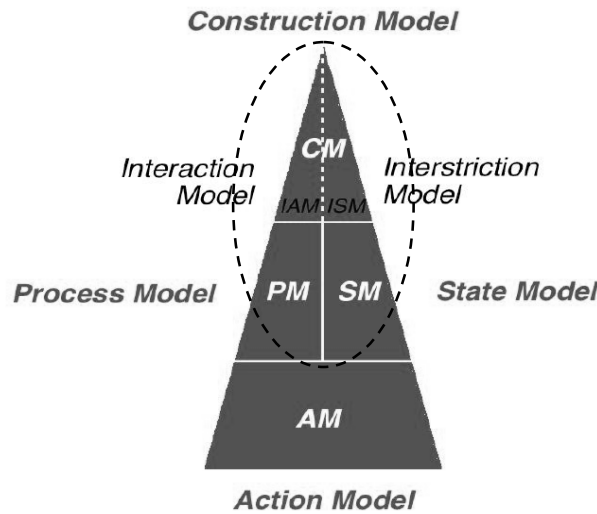
**Geographical:** The country which has been studied during the analysis phase is the Netherlands. Although the concept (safety-chain approach) used to describe the flood management domain is widely used internationally. Safety-chain-approach is explained in chapter two of this report.

**Organizational:** In this project, only the agencies and organizations involved in flood management domain in the Netherland is understudy. The initial focus lies in understanding the essence of construction and operation of these organizations using - with DEMO designed – ontological models. Rijkswaterstaat and water-board Delfland are contacted in person to gain insight into their roles in flood management related issues.

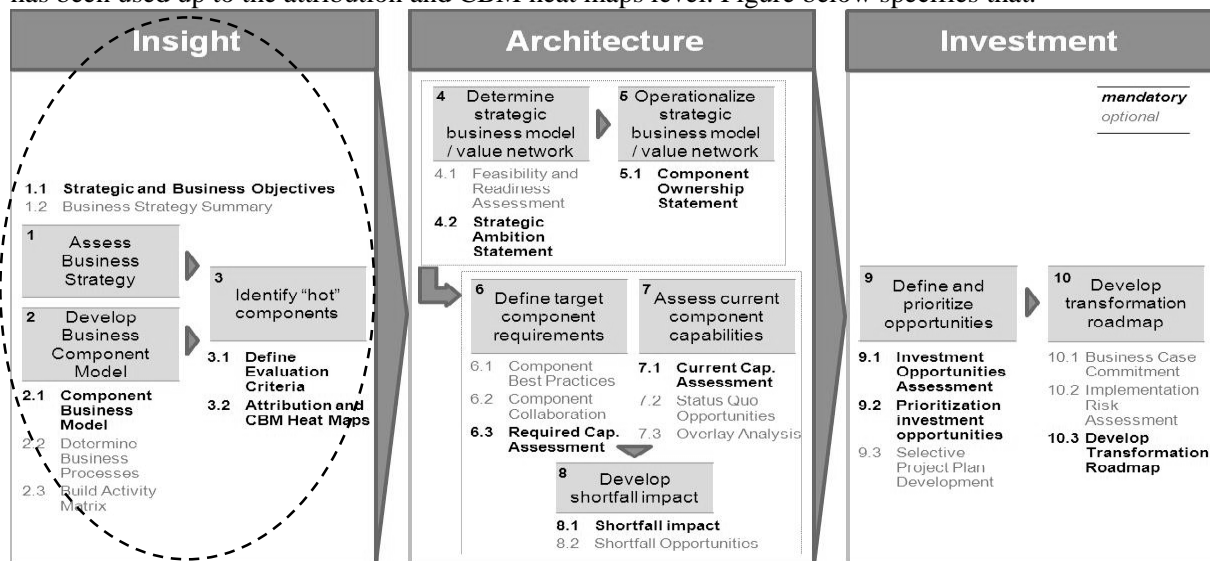
**Methodological:** Enterprise engineering is the discipline whose principles and methodologies steered the execution of this project. Two methodologies in this field namely DEMO (Design and Engineering Methodology for organization) and CBM (Component Business Model) of IBM are the chosen methodologies for this project. The usage of principles and techniques of theses methodologies in combination with each other are the main tools which allowed the fulfillment the project objectives. In addition to these methodologies some other tools such as objective-tree method of policy analysis paradigm [19] is used to specify the objectives domain under study.

The extent to which these DEMO and CBM methodologies are used in this project is as follows

DEMO methodology was used in the previous project (Ontology of Flood Control Domain [3]) upon which this project builds hence it is an inherited methodology. The ontological models (made with DEMO)available for of flood control domain used only three DEMO aspect models namely the Construction Model, the Process Model and the State Model, Action model is not yet implemented.



For generation of strategic focus areas of model of the flood control domain the CBM methodology which has been used up to the attribution and CBM heat maps level. Figure below specifies that.



A detailed explanation of these methodologies is presented in chapter 4 of this document.

## 2.6 Project organization

The project was supervised by two supervisors from one from the Delft University of Technology and another from IBM's Global Center of Excellence for Water Management. The project is executed by a master student from the Delft University of Technology. The project deliverables was be reviewed by each supervisor, to insure the required quality for the total output of the project. Supervisor from IBM was responsible for the availability of required resources for project and feed-back on usability and organization related aspects of the project. While the supervisor from Delft University of Technology provided the required feed-back on theoretical and scientific aspects of the deliverables. Project executor made sure the successful completion of project tasks and deliverables on schedule. Working location was determined on an ad-hoc basis. The main working location will be IBM Global Center of Excellence for Water Management in Amsterdam.

## 2.7 Recapitulation

Since the Hurricane Katrina in 2005, the Dutch have come to the realization that they cannot continue to rely for their safety against water only by protective physical measures like building stronger defenses, higher dikes and increased drainage to withstand the flood prone threats. Instead, a far more sustainable approach in flood control domain is needed to safeguard the natural functioning of wetland, coasts, rivers and delta's. This problem statement has led to the main question in this research which is got formulated as followed:

*“How to identify, specifies and represent the strategic focus areas (at enterprise level) in the flood control domain in the Netherlands?”*

The main research question is delineated into the following sub-question.

- 1 What are the essential building blocks of the flood control domain?
- 2 Among these essential building blocks, which one are of the relevance to the strategic objectives of the flood control domain?

From the above questions, the following objective was proclaimed for this project:

*“The engineering of an approach, which allows identification, specification and representation of the strategic focus areas of the flood control domain in the Netherlands.”*

This objective would constitute the followings sub-objectives:

1. Engineering of a generic approach or method, which allows identification, specification and representation of essential building blocks of a domain; such that the strategic focus areas of a domain can be specified in terms of these building blocks.
2. The application of this approach in the flood control domain in the Netherlands with the aim of understanding where the strategic focus areas lay.

The above mentioned objectives form a framework which firstly allows the water managers to identify the strategic focus points in flood control domain and align their own organizations strategy to that of the whole domain. Secondly it allows IBM to understand where the focus areas of its current and future potential clients in the water domain. Figure 2 visualizes this whole design process.

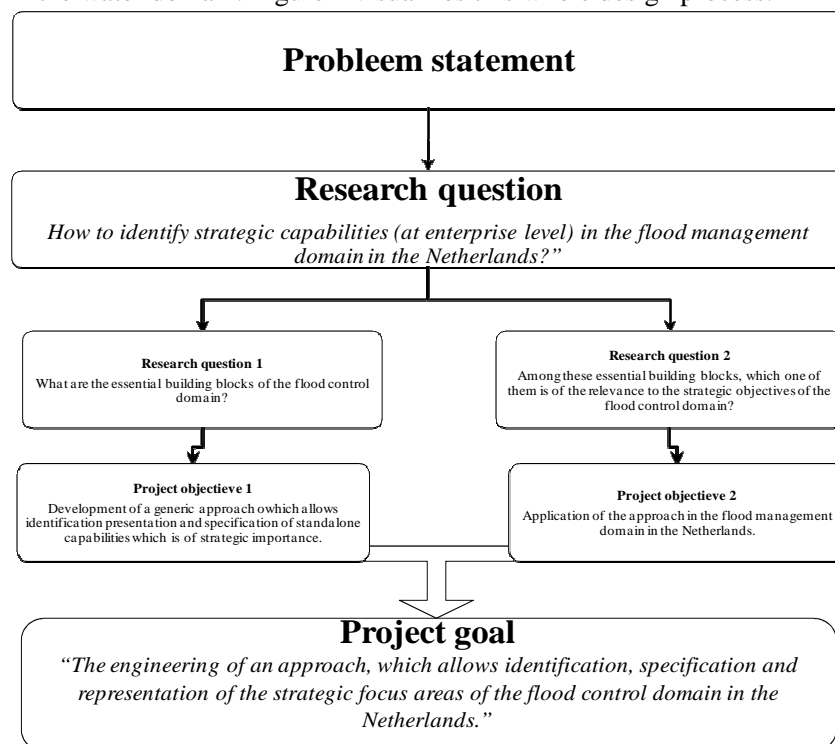


Figure 2: Summary of research design

### 3 Contextual conceptualization

This chapter describes the important features of the practical context of this research project. The content of this chapter allows the reader of the document to understand the environment and the context around which the research is conducted.

In the coming paragraphs of this chapter first a brief and formal description of flood as phenomena is given. Then the safety-chain approach is described which is an internationally known concept in world of disaster management. Followed by this a description of the flood control domain along with its main organization active in it is given. With the safety chain concept and the domain actor described, the whole of the flood control domain will be presented as the links of the safety-chain.

#### 3.1 Flood

The EU Floods directive defines a flood as a temporary covering by water of land not normally covered by water [21]. These are natural phenomena, which cannot be prevented. However, some human activities (such as increasing human settlements and economic assets in floodplains and the reduction of the natural water retention by land use) and climate change contribute to an increase in the likelihood and adverse impacts of flood events.

There are many different types of floods which can be described according to speed, geography or cause of flooding. The most common one are as follows

- Flash floods: In areas with steep slopes, heavy rain can cause a riverbed that held very little or no water at first, to suddenly brim with fast flowing water. The rain water is collected on the slopes, then flows downhill gathering speed and all the water comes together in the river bed. The water level rises fast. The water flows over the river banks and floods the area
- Coastal floods: These are caused by severe sea storms, or as a result of another hazard (e.g. tsunami or hurricane). A storm surge, from either a tropical cyclone or an extra-tropical cyclone, falls within this category.
- Urban floods: Flooding in urban areas can be caused by flash floods, or coastal floods, or river floods, but there is also a specific flood type that is called urban flooding. Urban flooding is specific in the fact that the cause is a lack of drainage in an urban area
- River floods: Rainfall over an extended period and an extended area can cause major rivers to overflow their banks. The water can cover enormous areas. Downstream areas may be affected, even when they didn't receive much rain themselves.
- Pending floods: This type of flooding happens in relatively flat areas. Rain water falling in an area is normally stored in the ground, in canals or lakes, or is drained away, or pumped out. When more rainwater enters a water system than can be stored, or can leave the system.

Floods are part of the dynamic variation of the hydrological or water cycle. Hydrological cycle describes the existence and movement of water on, in, and above the Earth. Earth's water is always in movement and is always changing states, from liquid to vapor to ice and back again. The water cycle has been working for billions of years and all life on Earth depends on it continuing to work; the Earth would be a pretty stale place to live without it[3]. To this must be coupled the nature of the terrain that generates the runoff (e.g. geology, soil type and vegetation cover), the antecedent conditions, the stream networks characteristics (e.g. storage capacity, channel length) and the channel characteristics (e.g. channel roughness and shape). Many of the most catastrophic floods are then associated with the intense rainfalls that result from hurricanes, cyclones and typhoons, particularly when this rainfall occurs on a steep catchment.

Floods are a threat to life, property and other valued resources. Flood disasters are among the world's most frequent and damaging types of disaster. Annually, flooding affects millions of people and their livelihoods. There is broad consensus that both the probability and the potential impact of flooding are increasing in many regions across the globe, particularly in delta regions. The series of river floods many

countries have experienced in the past decade are often attributed to climate change, and many experts expect the frequency of peak river discharges, hence river floods, to further increase in the future. Hurricane Katrina is generally perceived as another strong sign that the climate is changing more rapidly than many had expected a few years ago.

### 3.2 Safety-chain approach

The safety chain concept was originally developed by the Federal Emergency Management Agency (FEMA) in US as an approach to address safety and security issues. The original safety chain approach consisted of four links: mitigation, preparation, response and recovery.

This approach is well adopted in different countries and is addressed in various literatures about the crisis and disaster management [2].

In the Netherlands, the safety chain concept was introduced in 1993 with slight modification in which the mitigation link was divided into two links namely pro-action and prevention, while the other links have remained the same.

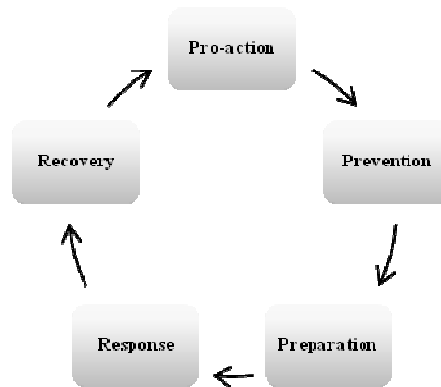


Figure 3: Safety Chain Approach

Table below describes the five links of safety chain concept.

Table 1 Safety chain links

Link	Description
<b>Pro-action</b>	Eliminate structural causes of accidents and disasters to prevent them from happening in the first place (e.g. prohibit building in flood prone areas).
<b>Prevention</b>	Take measures beforehand aimed at preventing accident and disasters, and limiting consequences in case such events do occur (e.g. building levees)
<b>Preparation</b>	Taking measures to ensure sufficient preparation to deal with accident and disasters in case they happen (e.g. contingency planning, training, early warning, initiating flood fighting efforts)
<b>Response</b>	Actually dealing with accidents and disasters (e.g. response teams)
<b>Recovery</b>	All activities that lead to rapid recovery from consequences of accidents and disasters and ensuring that all affected can return to “normal” and recover their equilibrium.

### 3.3 Flood control domain in the Netherlands

Flood control domain is an intersection of the water and disaster management domain.

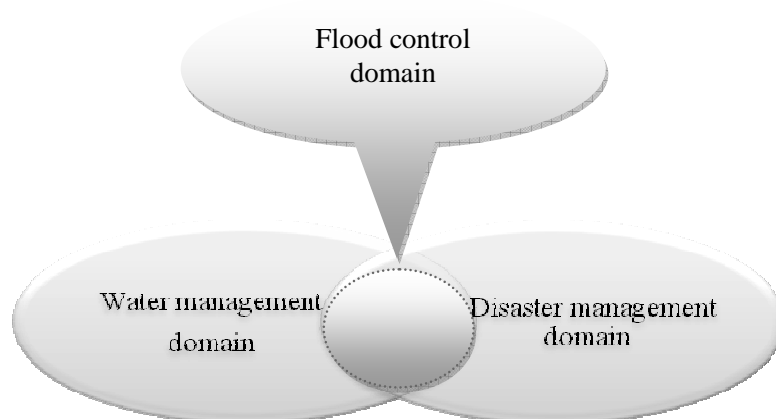


Figure 4: Flood control domain as an intersection of Flood and Disaster management domains

This domain in the Netherlands is of a special importance, because about two thirds of the country is vulnerable to flooding while at the same time the country is among the most densely populated on earth. Natural sand dunes and manmade dikes, dams and floodgates provide the defense against storm surges from the sea. River dikes prevent flooding from water flowing into the country by the major rivers Rhine and Meuse, while a complicated system of drainage ditches, canals and pumping stations (historically: windmills) keep the low lying parts dry for habitation and agriculture. Water control boards are the independent local government bodies responsible for maintaining this system. In modern times flood disasters coupled with technological development have led to large construction works to reduce the influence of the sea and prevent future floods. The actor network of which defines domain is listed in table. These actors will be represented in terms of organizations they belong to, roles they play and responsibilities that they have in water management and disaster management. The actors that form the flood management domain in the Netherlands are as follows [3].

Table 1 Flood management domain actors

VenW	Ministry of Transport, Public Works and Water Management
BZK	Ministry of the Interior and Kingdom Relations
RWS	Rijkswaterstaat
WD(RWS)	Inland Water Management and Water Treatment service of RWS
DID (RWS)	Data-ICT-Service of RWS
KNMI	The Dutch weather Institute
LCO	National Flood Threat Coordinating Commission
LOCC	National Operational Coordination Centre
NCC	National Coordination Centre
DCC	Departmental Coordination Centre
ROT	Regional Operation Team
CRAS	Central Damage Registration and Reporting Point
CRIB	Central Registration and Information Bureau
NRK	The Netherlands Red Cross
PIOV	Politie Instituut Openbare orde en Veiligheid
BAN	Bestuursacademie Nederland
COT	Crisis Onderzoek Team
SOSA	Stichting Opleiding en Scholing Ambulance Hulpverlening
NIBRA	Nederlands Instituut voor Brandweer en Rampenbestrijding
TMO	Flooding Taskforce Management
NBBE	Nederlands Bureau Brandweereexamens



### **3.4 Flood Control Domain as the five links of the safety chain**

In this the description of role and activities of above mentioned actors is provided in terms of five links of the safety chain concept. This description is the result of the case study which was conducted by the master thesis work Diana Mongula [3].

#### **3.4.1 Pro- action**

The water boards are required every 6 years to provide a report of the possible future flooded areas and about their spatial plans [source]. In order to provide such a report, they perform flood analysis. The result of flood analysis is a report, which can aid in the formation of a map, showing the possibility of flooding in certain areas, for instance in the coming 100 years. Among the data that the water boards need to perform flood analysis include the following: the average rainfall data obtained from the Royal Dutch Meteorological Institute (KNMI), elevation data which is obtained from Rijkswaterstaat and the internal data that comes from the water boards themselves such as different flooding scenarios.

Based on flood analysis, the Water boards develop spatial plans. Spatial plans are one of the measures that can be taken to reduce the risk of flooding and protect water resources. Spatial measures address land use, and exclude the construction of built-up areas in sensitive locations and changes in land use so that the area can also be used as an artificial water basin, etc., when necessary. For making spatial plans, the water boards also get inputs from the European Commission located in Brussels and from the Ministry on the policy issues that should be taken into account.

The water boards send their reports to the municipalities and the provinces. These authorities use the water board's reports to make land use plans. Land use authorities: the municipalities, the provinces or the national government can initiate land-use change, for example, the development of urban areas, infrastructures, or natural environments. In order to implement land use change, the initiator has to develop a land use plan. Among the things needed to assess a land-use plan is the Water Assessment Test (WAT). The WAT is a general framework for assessing land-use proposals. The WAT framework consists of a checklist and a clarification of the roles of the actors involved. The framework includes all relevant water management aspects (flood protection, water quality and depletion). A WAT has three types of actors: the initiator, the advisor and the reviewer [9]

The initiator is the land-use authority that wishes to implement a land-use change, for example, the development of urban areas, infrastructures, or natural environments. This can be a local, regional or national authority. As already mentioned, this can be the municipality, the province or the national government. However, the initiator can also be a private organization. In such cases, the responsible public authority (municipal, provincial or national) performs the WAT.

The advisor is the water authority with jurisdiction: the water board, groundwater authority or national Rijkswaterstaat. The water authority assists the land use authority in conducting the water assessment test. If water management priorities (collect, store, and discharge) cannot be realized, explanations must be provided and compensatory measures taken. The water authority proposes mitigation and compensation measures that can be taken. The water authority then advises the land use authority on how the water management aspects can be incorporated. However, it is the responsibility of the land use authority to decide whether to incorporate the proposed mitigation and compensation measures.

The land use decision then has to be reviewed according to urban and regional planning legislation. For example, the provincial authority reviews land-use decisions taken by municipal authorities. Finally, the land use authority can implement the land use plan.

#### **3.4.2 Prevention**

Without flood defenses such as dikes and dunes, more than half of the Netherlands would be regularly inundated. So, the extensive system of flood defenses is essential to the safety and habitability of the country and an absolute precondition for healthy economic development.

There are two main categories of flood defenses in the country: primary and secondary flood defenses. All flood defense structures along the major rivers of the Netherlands and the area around Lake IJsselmeer (including Lake Markermeer) and the delta are part of the primary flood defense system. The total length of these primary flood defenses is over 4,000 km, consisting of dikes, dams and dunes; they include over 800 structures such as pumping stations, navigation locks and quay walls. These defenses are managed 90% by the water boards and 10% by Rijkswaterstaat.

All other flood defense structures are generally identified as regional or secondary flood defense structures. There are 14 000 km of secondary flood defense structures, including regional river dikes (for the smaller rivers), storage basin dikes, dikes/flood defense structures used to separate areas with different functions (compartment dikes), polder dikes and dikes/flood defense structures dividing differences in ordnance datum, all of which are managed by the Water boards.

These flood defenses have been constructed according to specific standards. For instance, the safety standard for the primary flood defenses ranges between 1/250 per year (upriver) and 1/10,000 (coast) per year. This safety standard is defined as the probability of exceedance of the hydraulic conditions.

In order to achieve the same level of protection against flooding, the flood defenses need to be maintained in the future. The Water Embankment Act requires the water boards and Rijkswaterstaat to report on the safety assessment of primary flood defense every 5 years. The safety standard that includes guidelines (VTV) and hydraulic boundary conditions (HR) for safety assessment is established by the Directorate General Water within the Ministry of Transport, Public Works and Water Management. The water boards and Rijkswaterstaat conduct the safety assessment. During the assessment, they check whether the strength of the flood defenses meets the statutory safety standards. The assessment of a flood defense can lead to three categories: the flood defense “meets” the standard, the flood defense “does not meet” the standard, or because of insufficient information “no judgment” can be made.

The water boards and Rijkswaterstaat send their assessment reports to the provincial authorities that make an assessment, which is then attached to the reports and submitted to the Minister of Transport, Public Works and Water Management. Based on its independent position, the Transport and Water Management Inspectorate evaluates whether the assessment or management has been conducted in accordance with the regulations (this is known as official judgment). The results are summarized to create a national picture and analysis is provided together with its findings and conclusions. The Transport and Water Management Inspectorate submits this report to the Minister of Transport, Public Works and Water Management. Based on the summary, the minister informs Parliament about the state of all the primary flood defenses in the country and draws up a program of improvement, known as the Flood Protection Program. During the safety assessment period, preventive maintenance can be performed when the condition of flood defense seems to be threatening. Such maintenance can be called “variable maintenance,” as it is performed after the safety assessment when the condition of flood defense is identified to be threatening. However, there might be a fixed maintenance, performed in particular time interval to ensure good condition of flood defenses. For the maintenance to be implemented, a maintenance plan has to be developed. Such a plan includes things like an area that will be maintained, the equipment that will be used, personnel, maintenance period and maintenance cost. The maintenance plan needs to be approved before the maintenance is implemented.

As already mentioned, an improvement program is drawn based on the safety assessment results. In order to conduct an improvement program, an improvement plan has to be established. This plan can be established by the flood defense manager, the water board or Rijkswaterstaat. The improvement plan contains the necessary project provisions as well as mitigating and compensating measures for damage done. Moreover, the plan clarifies which measures will be taken to promote the values of landscape, nature, and cultural heritage, the so-called LNC-values. The established plan has to be approved by the province involved before the improvement is implemented. The flood defense improvement implementation has to be inspected to check whether the improvement is done according to the established and approved plan. The flood defense inspection role is the responsibility of the Transport and Water Management Inspectorate.

### 3.4.3 Preparation

Flooding in the Netherlands is fortunately rather uncommon. This means that the practical knowledge of how to deal with threats of extreme floods and actual flooding is limited. To raise preparedness among all parties involved in flood response and recovery, flood disaster plans or high-water plans are prepared. In addition to the flood disaster plans, training is organized within individual groups with a role in the decision-making chain to practice skills related to their individual task.

The government authorities (i.e. municipality, region and province) are responsible for the preparation and updating of flood disaster plan or high-water plan. Such plans need to be checked periodically for reviews. A good example of a region in the Netherlands with such a plan is the region of Nijmegen. Because of the possibility of floods and the threat of a dike breach, a disaster plan was developed for the region of Nijmegen in the early 1980s. After the flood of 1993 from the river Meuse and the fact that there appeared to be real threat of weakening and breaching of the dikes along the river Waal, the board of mayors from the region decided to update the plan. At the end of 1994, this model was accepted and sent to other regions in the province. Although the other regions had not formally accepted this plan before the 1995 flood occurred, most of the regions could use it as a guideline for their response to the flood. Among the issues dealt in this plan include the following: inundation scenarios, evacuation planning for persons, evacuation planning for animals, communication plan and information for the population. Because the region was well-prepared, it was possible to evacuate about 60,000 people in the region of Nijmegen. The successful evacuation of Nijmegen gave confidence to the other regions that an evacuation of a large number of people was possible.

Apart from the regional flood disaster plans, the National High Water and Flooding Emergency Response Plan have been developed recently. Such a plan was deemed to be necessary in the event of high water. The (impending) disaster will strike multiple regions simultaneously, and regions that are not hit will also be involved in coming to the aid of the affected regions and in the care of people evacuated from the regions. Here, the preparations confined to municipal or regional level are insufficient.

As already mentioned, training is also used to raise preparedness among parties involved in flood response and recovery. By implementing multidisciplinary training courses and large-scale exercises, the government is ensuring that relief workers can acquire the right kind of knowledge and skills for potential disasters, so that when needed, they can carry out their tasks efficiently and effectively. Training is also used to test the established flood disaster plans or the high-water plan. Tests will always be needed to establish whether the established plans work, which is why exercises are the final step in effective preparations. For example, in November 2008, large-scale training was conducted in the Netherlands that involved many stakeholders in the water domain and safety domain. The Flooding Taskforce Management (TMO) was in charge of organizing the large-scale flooding exercise in November 2008. Large-scale training sessions are infrequently conducted, as compared to small-scale training sessions. Due to the importance of training for disasters in the Netherlands, several training institutions recently combined forces and founded a consortium to provide training courses to anyone involved in disaster control or crisis management. This consortium includes Bestuursacademie Nederland (BAN), Crisis Onderzoek Team (COT) of the University of Leiden, Nederlands Bureau Brandweerexamens (NBBE), Nederlands Instituut voor Brandweer en Rampenbestrijding (Nibra), Politie Instituut Openbare orde en Veiligheid (PIOV), and Stichting Opleiding en Scholing Ambulance Hulpverlening (SOSA)(Interior Affairs). After the training has been conducted, an evaluation regarding measures and the whole flooding process has to be performed. The evaluation is important since during training or a real flood crisis, a new scenario may unfold that was not in the flood disaster plan. As a result, it may take a long time to figure out who could resolve issues presented during such a scenario and how those issues could be resolved. If necessary, and when it is foreseen that such a scenario can happen again in the future, the manager of the flood disaster plan may decide to update the existing flood disaster plan to include the new scenario.

### 3.4.4 Response

The response phase deals with operations that are directed at managing, containing and combating the consequences of an imminent flood (also referred to as high water) even before the actual flood have occurred. High water occurs when the water rises above a specific pre-defined level; the water defenses have not yet been breached. Although in this situation the disaster has not (yet) taken place, it is considered a crisis situation and large-scale action is taken: full crisis control measures are mobilized (pre-crisis response). This situation thus differs from that of many other types of emergencies (post-crisis response). High water can, but not necessarily, be followed by flooding. In this phase, we will consider actions that are taken not only during the actual flood, but also during an imminent flood.

Therefore, we can say that the response phase starts when a flooding event is predicted through flood forecasting activity. The Inland Information Centre within RIZA, Rijkswaterstaat Regional Departments and the water boards are responsible for daily water level measurement and water level forecasting at the national, regional and local levels, respectively. Under normal conditions, water level forecasting is done every morning, mainly for the benefit of navigation. In times of flood, forecasts are made at least twice a day, again for navigation but also for river management authorities, crisis organizations and population.

Among the data needed for flood forecasting is the data about water level measurements and weather forecasts. The water level measurements are collected every 10 minutes by the Geo-Information Department. The Royal Netherlands Meteorological Institute (KNMI) provides weather forecasts on an hourly basis to government agencies, commercial weather bureaus, broadcasters and media.

Flood forecasting organizations mentioned above use a high-water scaling up procedure as a guideline to initiate crisis actions. This procedure shows what actions can be taken when a certain water level is reached and/or expected to increase.

After a flooding event is predicted, the forecasting authorities warn water management authorities and/or crisis organizations according to the high-water scaling level. Operational high-water management is among the activities that are initiated early when a flooding event is predicted. The water boards and Rijkswaterstaat are responsible for the operational high-water management. They can propose several operational high-water management measures such as pumping out of water, deciding to flood a certain retention area, etc. The effects of the proposed measures are analyzed in advanced before they are selected as the right measures that will be implemented.

Another activity that is also initiated during the early stages of a flooding event is the periodic monitoring or inspection of flood defense such as dikes. The information about the condition of dikes is important for initiating actions like evacuation. It is the role of the water boards to provide the information about the condition of the dykes to other crisis organizations. To do that, the dyke guards are called to inspect the conditions of the dykes. Based on the inspection, or because of known condition of the dyke, the water boards can initiate temporary dyke reinforcement measures such as sandbagging. Because a lot of manpower is needed to perform sandbagging activity, the water boards request additional help from the local people and the army.

During a flood crisis, operational effort needs to be coordinated. At the national level, LOCC is responsible the efficient, coordination of manpower, resources and expertise (the fire service, police, emergency medical aid (offered by the GHOR and Ministry of Defense) if there is a threat or acute serious crises. Regionally, the coordination of operation efforts is the responsibility of the Regional Operation Team (ROT). Therefore, in case a flood crisis is coordinated nationally, it is the responsibility of LOCC to ensure the availability of operational resources. To achieve that purpose, LOCC periodically analyzes operational resources by checking what resources are available, where these resources are and how many resources are needed. In case of insufficient operational resources, LOCC drafts an advice report requesting additional resources. The decision for additional resources is taken at the Inter Ministerial Policy team meeting.

Once a flooding is predicted, people need to know about the possible flooded areas and the time of the flooding. This information is provided locally by the water boards. At the national level, the National Flood Threat Coordinating Commission (LCO) becomes responsible. LCO is activated and managed by the Departmental Coordination Centre within the Ministry of Transport, Public Works and Water Management. The water boards and LCO perform an analysis for the possible flooding areas and flood break time. In order to perform the analysis, a combination of information is required including the water level measurements, weather forecast, flood forecast and the condition of the threatened water defenses. Based on their analysis, the LCO advises the Inter Ministerial Policy Team and the Ministerial Policy Team of the chance that the threatened area will actually be flooded, the size of the (potential) flood area and the time left before the flood breaks.

In addition to the prediction of possible flooded areas and flooding time, the effects of flooding in terms of casualties and economic damage in the predicted areas need to be analyzed in advance. This information is important to initiate actions that aim to reduce flooding effects such as evacuation. The municipalities perform both the causality analysis and economic damage analysis.

Due to the possibility of flooding, evacuation preparations are initiated. On one hand, some authorities are responsible for the preparations of evacuation implementation. In doing so, they develop an evacuation plan and prepare resources needed for the evacuation purpose. Among the things included in the evacuation plan are the required evacuation time, the exit points and evacuation routes that people can take to evacuate from the flooded area. An evacuation plan and evacuation process discussed here is a general one. However, specific evacuation plans must be integrated together. For instance, these plans may be specific for population in a threatened area without a need of assistance, the population in a threatened area with the need of assistance (e.g. the nursing homes, the patients in hospitals), prisoners and animals.

On the other hand, some authorities are responsible for checking whether an evacuation has to be done. In doing so, an evacuation decision-making process is initiated. At the national level, if a disaster affects more than one province or country, the Minister of Interior Affairs decides on evacuation. If a disaster affects a single province, the Queen's Commissioner can decide to evacuate the population. Regionally, if flooding affects more than one municipality, the appointed coordinating Mayor within a region can decide on evacuation. Locally, when a single municipality is affected, moreover, and this is very rare for a flooding disaster type in the Netherlands, the Mayor of the municipality could decide on the evacuation.

Let's consider a flooding crisis coordinated at the national level. Therefore, the evacuation decision is made by the Ministry of Interior Affairs. He does this after consulting with the regional authorities and Queen's Commissioners and discussing the decision in the Ministerial Policy Team meeting. Among important information needed for evacuation decision making is the available time (i.e. the time from the moment of the warning to the anticipated moment of flooding) and the required time (i.e. the time required to evacuate all inhabitants from the disaster area). Depending on the way in which these timeframes interrelate, the Minister of Interior Affairs will decide whether or not to evacuate wholly or partially on the ground of the Population Evacuation Act. Once an evacuation has been decided, some relief activities will focus on implementing the evacuation, some relief activities will focus on measures to manage or cordon off the area (prevent further disaster after the flood), while other relief activities in the non-threatened regions/provinces will focus on setting up shelters, implementing shelter care measures and registering evacuated victims. LOCC coordinates all these activities. In doing so, LOCC mobilizes the necessary operational resources required for carrying out these activities. Moreover, traffic control measures need to be implemented in case a large-scale evacuation is implemented. Without implementing traffic control measures, it may be impossible to evacuate a large population within a certain time limit.

### 3.4.5 Recovery

As already mentioned, the recovery activities ensure that the affected population can return to its normal routines. Recovery operations should commence as early as possible during flood response operations. Therefore, it is important to note that the links in the safety chain approach are not sequential. They can be regarded as aspects of management, not phases.

While in evacuated shelters, people register for damage settlement and the damage claims are organized. This registration is done by the Central Damage Registration and Reporting Point (CRAS) team. The state government is responsible for the claim payments.

Another concern during this period is the restoration of flood defenses to normal operations. In doing so, the repair of failed flood defenses is initiated. Each repair has to be planned. Among the things that are included in the repair plan are resources that will be used and the cost of repair. The developed repair plan has to be approved before the repair work is implemented.

Moreover, other authorities research when people can return. The water board councils and LCO perform the return analysis. Based on their analysis, LCO provides advice to the Ministerial Policy, which then decides on scaling down crisis activities in consultation with the highest administrative parties. Based on the LCO's advice, the Ministry of Interior Affairs can decide whether to return evacuated victims to their original homes; LOCC coordinates the return. In doing so, LOCC mobilizes operational resources needed for implementing the return activity.

Finally, the whole flood crisis has to be evaluated, regarding measures taken. An evaluation document will provide an insight and can be used to provide lessons to all the organizations that were involved during the crisis. Such lessons can be used to update existing flood scenarios as well as the flood disaster plan or high-water plan.

### 3.5 Recapitulation

The aim of this chapter was to present the flood control domain in the Netherlands in terms of safety chain approach. In doing so we defined flood as a temporary covering by water of land not normally covered by water [21] and the flood control domain as an intersection of the water management and disaster management domain. Through this we have described the main actors of the domain and finally presented the whole of the domain from the safety-chain perspective, which lead to the following above-distribution of the domain actor across the five links of the safety chain approach.

**Pro-action:** actors involved in this link include the national, provincial and local governments as well as the water boards.

**Prevention:** the main actors are the water boards and the Ministry of Transport, Public Works and Water Management together with its divisions, especially the Rijkswaterstaat.

**Preparation:** the primary factors responsible for specifying activities in this link are the municipalities. The provinces have regulatory authority over the municipalities. The Queen's Commissioner (in the provinces) ensures administrative coordination with and between municipalities, state services and other authorities and bodies. At national level, the Ministry of the Interior Affairs and Kingdom Relations plays a coordinating role.

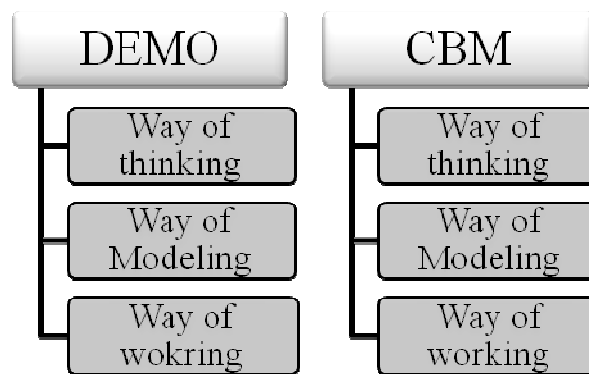
**Response:** according to the Disaster and Major Accidents Act, the municipal mayors are in supreme command and, as a result, municipalities play a central role in the response link. Disaster control is initially carried out by the emergency services (police, fire brigades, medical aid). However, when the situation becomes more serious or transcends the boundaries of one municipality, provincial or even national authorities (especially the Ministry of Home Affairs) may decide to coordinate or otherwise intervene.

**Recovery:** all government authorities will play a role in recovery. However, an important role in the recovery link is reserved for the State within its financial capabilities.

With this the contextual conceptualization of the research work got completed.

## 4 Theoretical Inventorization

This chapter describes an inventorization of the modeling methodologies and their underlying theories along which this research is organized. This inventorization is performed with the intention to quantify the contribution of these methodologies as tools in which can serve the successful realization of the research objectives. These theories and modeling methodologies include, enterprise engineering as a discipline, which forms the theoretical foundation of this work, along with two modeling methodologies in this discipline namely DEMO and CBM. The reason for choosing these methodologies lies in the methodological scope of project, which got described in section 2.5 of this document. In the coming paragraphs of this chapter first a brief description of enterprise engineering discipline, along with its three important notions (enterprise ontology, enterprise architecture and enterprise governance) will be given. Followed by this an overview of both DEMO and CBM will be given by elaborating on the three important dimensions of each methodology which are: *way of thinking*, *way of modeling* and *way of working*. After that a comparative analysis of DEMO and CBM will be done to see how they can be of value for this project.



**Figure 5: Three dimensions of DEMO and CBM**

Before starting the main contents of this chapter it is important to provide a description of the framework along which we will describe the DEMO and CBM methodologies. Figure 5 illustrates this framework.

The *way of thinking* identifies the philosophy and theoretical basis of a methodology. In other words the answers to philosophical questions concerning ontological, epistemological and other related concepts of philosophy are included in this part. For example, the definition of system, environment, nature of entities inside the system, the interaction of these entities with each other and the environment belong to the way of thinking.

The *way of modeling* of a methodology allows the expression of its way of thinking. It is mostly expressed as a set of models which are represented in that methodology. Models are the most identifiable aspects of a methodology. Each model is recognized by several modeling concepts and their representations (signs or graphic symbols). Moreover, each model may include inherit modeling concepts which have interrelations with other modeling concepts. The way of modeling holds the information about these modeling concepts and their interrelation as well.

The *way of working* is composed of a set of tasks with their subtasks and possible orders of those tasks that needs to be performed to allow the expression of the way of thinking through the way of modeling. It includes instructions that explain how to perform each task what form of input is needed and what is the intended output etc. These set of tasks are categorized into modeling and non-modeling tasks. Any action in which a model is produced or changed in any way is called a modeling task. Other types of tasks are considered as non-modeling tasks. The scope and information interdependencies of modeling tasks are

captured by modeling concepts which clarify the close relation between the way of working and the way of modeling.

#### 4.1 Enterprise Engineering

Strategic changes in today's modern enterprises are marred due to the lack of comprehensive knowledge about both the constructional and operational complexities that mark the enterprise. According to [14] strategic failures is mostly the avoidable result of inadequate strategy implementation rather than being the inevitable consequence of a poor strategy. This lack of knowledge is the result of shortcomings in traditional organizational paradigms in assisting enterprises to adapt their strategies and to implement them effectively and flexibly. The key reason behind this shortcoming is the predominant behavioral approach or black-box thinking of the traditional paradigms. Whereas strategic changes within an enterprise requires an engineering approach or (white-box thinking).

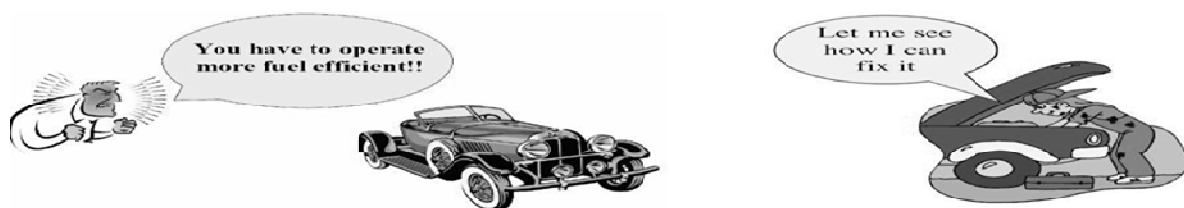
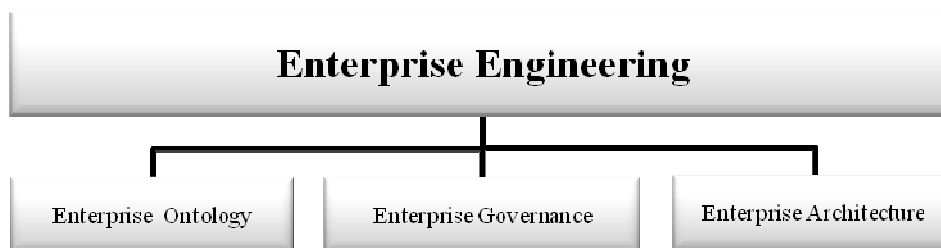


Figure 6 Behavioral vs. engineering approach (Dietz 2008)

In the presence of such issues, a new discipline is needed which views the enterprise as a purposefully designed system which in turn can be (re)designed and (re)engineered. This discipline must introduce new skill which enables its practitioners to (re)design, (re)engineer, and (re)implement an enterprise in a comprehensive, coherent and consistent way such that it operates as an integrated whole. Enterprise engineering is this needed new discipline, which provides the skills needed to deal with the above issues. However, enterprise engineering in practice is an encapsulation of three notions without which it would be either content-less or a jungle of tools and ideas. The three notions are Enterprise Ontology, Enterprise Architecture, and Enterprise Governance [15].



**Enterprise ontology** is a representation of the essence of construction and operation of an enterprise. By essence it means that the representation is fully independent of the current or future realization and implementation details of the organization. This implementation independence property of the ontological models compared to implementation related models offers a reduction of complexity of over 90% [1]. This reduction in complexity makes organizational models intellectually manageable and transparent for the managerial-level uses and reveals the internal and external coherence between components of an enterprise, like business processes, workflow, organization structure etc.

**Enterprise Architecture** is the whole set of design principles that are applicable to the re-designing and (re)-engineering of an enterprise. Three partial architectures are distinguished namely: the business architecture, the application architecture and technical architecture.





**Enterprise Governance** is the organizational competence for continuously exercising guiding authority over enterprise architecture development and the subsequent design implementation.

## 4.2 Design & Engineering Methodology for Organizations (DEMO)

### 4.2.1 Way of thinking

DEMO is a methodology, which is used for generating ontological models of an enterprise. The theatrical background of DEMO lies in PSI theory, which is the underlying theory for the notion of enterprise ontology. This theory identifies the principles and definitions of the system and entities within that system or in other words it defines the world, the existing entities in it, the behavior of these entities and their interdependencies. DEMO allows enterprise engineers to model the “essence” of construction and the operations of organizations. It focuses at extracting the essence of an organization from its actual appearance. Based on this DEMO presents five axioms that help to achieve this goal, which can also be considered as the way of the thinking in DEMO.

The five axioms are formally described as follows:

**Table 2: DEMO’s way of thinking**

<b>Axiom</b>	<b>Description</b>
<b>Operation</b>	The operation of an enterprise is constituted by the activities of actor roles. In doing so, these subjects perform two kinds of acts: production acts and coordination acts. These acts have definitive results: production facts and coordination facts respectively.
<b>Transaction</b>	The transaction axiom defines the relationship between these acts; whereby a transaction can be defined as a universal pattern in which coordination acts are performed, always involve two actor roles and are aimed at achieving a particular result. A transaction consist of three phases: the order phase (O-phase), the execution phase (E-phase) and the result phase (R-phase)
<b>Composition</b>	Describe the interrelations between the transactions
<b>Distinction</b>	The distinction axiom states that there are three distinct human abilities playing a role in the operation of actors, called Performa, Informa and Forma Pefroma: form aspect of communication and information Infroma content aspects of communication and information Forma concerns the bringing about of new, original things, directly or indirectly by communication
<b>Organization</b>	The organization theorem states that the organization of an enterprise is a heterogeneous system that is constituted as the layered integration of three homogeneous systems: the B-organization (from Business), the I-organization (from Intellect), and the D-organization (from Document). The relationships among them are that the D-organization supports the I-organization, and the I-organization supports the B-organization. The integration is established through the cohesive unity of the human being.

### 4.2.2 Way of modeling

The modeling of an enterprise, as a collection of collaborating *crispies*<sup>1</sup> is not a straightforward activity since be voluminous and at the same time incomprehensive and mostly inconsistent. Therefore, it is necessary to develop enterprise ontology in a systematic manner. That is why DEMO contains a set of aspect models, which allows the ontological knowledge of about an enterprise to be expressed in a consistent manner, such that this knowledge is easily accessible and manageable. F

**Table 3 DEMO's way of modeling**

Model	Description
<b>Construction Model</b>	Regards the construction of the enterprise system (the organization), specified by transaction types, actor roles (plus initiator and executor links), and information banks (plus information links).
<b>Process Model</b>	Regards the state space and process space of the coordination world, specified by business events and business laws
<b>State Model</b>	Regards the state space and process space of the production world, specified by business object classes, business fact types, and business laws.
<b>Action Model</b>	Regards the operation of the enterprise system, specified by business rules (that are the operational equivalent of the business laws).

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<sup>1</sup> An organization is formally defined by a tuple  $\langle C, R, I, S, P \rangle$ , where  
 C : a set of C-facta, called the coordination base  
 R : a set of action rules, called the rule base  
 I : a set of intentions, called the intention base  
 S : a set of facta and stata, called the state base  
 P : a set of P-facta, called the production base

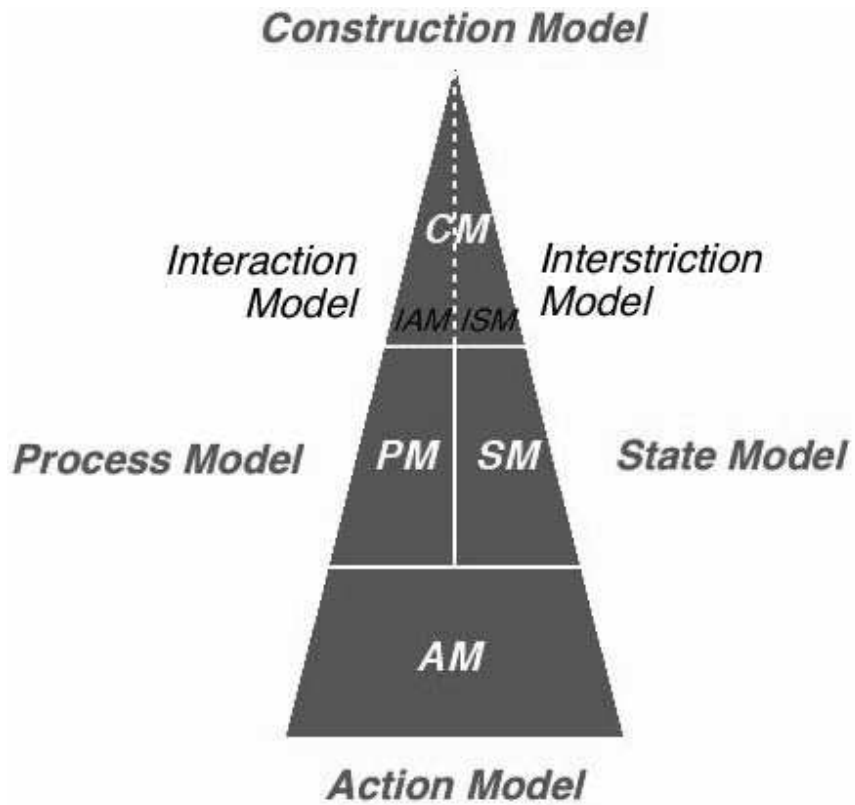


Figure 7: The ontological aspect models of DEMO

### 4.2.3 Way of working

The general elicitation method to acquire the basis for a correct and complete set of aspect models of motioned above an enterprise ontology consists of three analysis and three synthesis steps. The starting point is all available documentation about the enterprise, of whatever kind, and in whatever form. The table below gives description of every analysis and synthesis step.

**Table 4 DEMO's way of working**

Activity Name	Type	Description	Input	Output	Axiom
1. Performa Informa Forma analysis	Analysis	In this step, all available pieces of knowledge are divided in three sets, according to the distinction axiom. This is always an easy job, since in natural language descriptions words and sentences may belong to more than one of these sets.	Case Description	Performa Informa Forma	Distinction axiom
2. The Coordination-Actors Production analysis	Analysis	The Performa items are divided into C-acts/results, P-acts/results, and actor roles; according to the operation axiom This step goes rather straightforward since the three kinds are well distinguished in textual descriptions.	Performa items	acts/results, P-acts/results	Operation axiom
3. Transaction Pattern Synthesis	Synthesis	The transaction pattern, according to the transaction axiom is juxtaposed over the results so far, as a template, in order to cluster them into transaction types. Next, for every transaction type, the result type is correctly and precisely formulated. The Transaction Result Table can now be produced.	C-acts/results, Pacts/results	Transaction Types TRT	Transaction axiom
4. The Result Structure Analysis	Analysis	Based on composition axiom, every transaction type of which an actor in the environment is the initiator may be conceived as delivering a result to the environment. Generally, the (internal) executor of this transaction type is initiator of one or more other transaction types, and so on. The results of these cascaded transactions can be viewed as components of the end result.	Transaction Types		Composition axiom
5. Construction synthesis	Synthesis	For every transaction type, the initiating actor role(s) and the executing actor role are identified, based on the transaction axiom. This is the first step in producing the Actor Transaction Diagram.		Actor role	Transaction axiom
6. Organization synthesis	Synthesis	A definite choice has to be made as to what part of the construction will be taken as the organization to be studied and what part will become its environment. The Actor Transaction Diagram can now be finalized.			

### 4.3 Component Business Model (CBM)

#### 4.3.1 Way of thinking

IBM's CBM is a different and relatively new way of looking at an enterprise. It represents the entire enterprise in a simple framework that can be fitted on a single page. It is an evolution of traditional views of an enterprise, such as business unit, function, geographic or process.

Using CBM, IBM's consultants identify the basic individual components (i.e. building blocks) which as whole form the enterprise. These components may include the people, processes and technology it needs to fulfill its function that is to deliver value to the enterprise it belongs. After a comprehensive analysis, which includes identification and defining of the composition of each component of the enterprise, the components are mapped, onto the capability matrix, which represents the level of responsibility against value chain. Each component business map is unique to each business it represents.

Table 5: An example of a CBM map without components

	Manage	Design	Buy	Make	Sale
Direct					
Control					
Execute					

The columns are created after thorough analysis of a business's functions and value chain. The rows are defined by actions. The top row, "direct," represents all of those components in the business that set the overall strategy and direction for the organization.

The middle row, "control," represents all of the components in the business that translates those plans into actions, in addition to managing the day-to-day running of those activities. The bottom row, "execute," contains the business components that actually execute the detailed activities and plans of an organization.

The component business map shows activities across lines of business, without the constrictions of geographies, internal silos, or business units. The Component Business Map lets a representation of entire enterprise on a single page. This single page representation of the enterprise provides a view which independent implementation level details that could potentially hamper the ability to bring about strategic changes. This componentized view allows identification of capabilities and gaps that need to be addressed and opportunities to improve efficiency and lower costs across the entire enterprise. Identify the components where you can realize the greatest impact, and start there. In addition, that is where one can begin unlocking value hidden in the company and effecting strategic change. CBM sees the enterprise as collection of components (building blocks), business components are the modular building blocks that make up the specialized enterprise. Each component encompasses five dimensions. Figure 8 represents a visualization of the components in terms of its five dimensions.

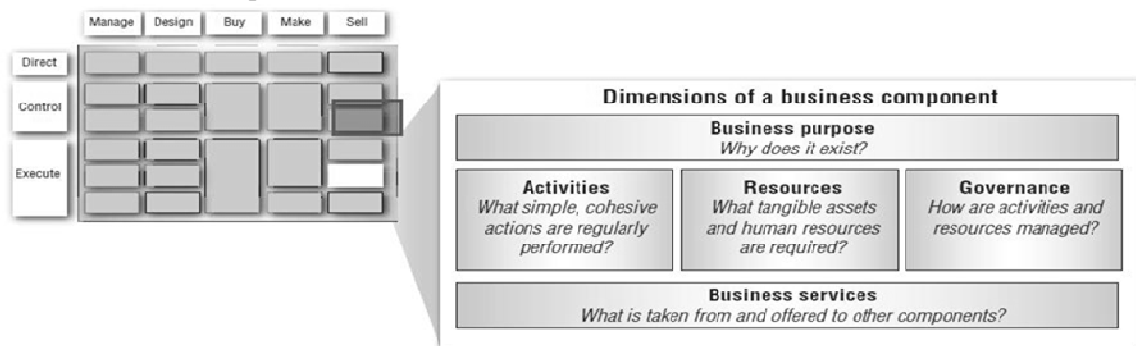


Figure 8 CBM's way of thinking

### 4.3.2 Way of modeling

According to CBM models components aggregate business activities into discrete modules that can be shared across the firm. However, how do components work together within the context of an overall business model? As Figure 5 shows, CBM provides a framework for organizing components by competency and accountability level.

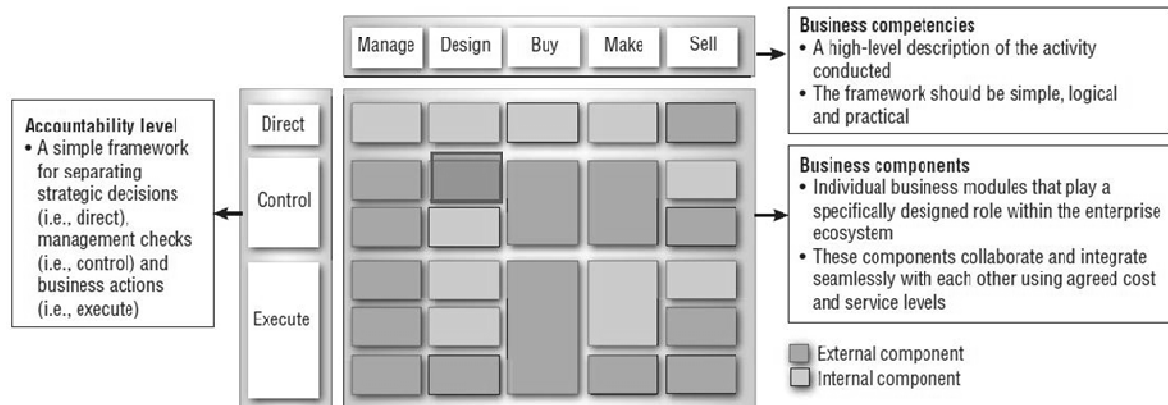


Figure 9 CBM's way of modeling

The map structure is quite instrumental:

- The columns are created after thorough analysis of competencies within the organization (e.g. value-chain).
- The top row, **Direct** represents all of those components in the business that set the overall strategy and direction for the organization.
- The middle row, **Control** represents all of the components in the enterprise that translates those plans into actions, in addition to managing the day-to-day running of those activities.
- The bottom row, **Execute** contains the business components that actually execute the detailed activities and plans of an organization.

### 4.3.3 Way of working

CBM practitioners take a three-phased approach to deliver CBM maps:

1. **Insight:** The Insight phase is a series of analysis, designed to record business priorities and objectives, which defines the supporting target Business Component Model. It ensures that future investment in processes, systems and organizational change is aligned with business strategy. In the Insight phase an enterprise is modeled as a network of collaborating, specialized components (with no overlap). Based on client issues and strategic and business objectives the components are prioritized and “hot” components are selected and agreed
2. **Architecture:** The Architecture Phase evaluates the impact of shortfalls between current and required capabilities, to support the confirmed and refined business strategy and corresponding Business Operating Model in terms of processes, IT-infrastructure, people, assets, governance, and alliances. Agreed strategic ambition statement and component ownership statement, indicating component ownership / sourcing. Assessment of current and required component capabilities to support business strategy and evaluation of impact of shortfalls.
3. **Investment:** The Investment Phase develops a transformation roadmap that coordinates the incremental realization of benefits. Steps in this phase can be performed with some overlap and iteration as the roadmap evolves and subsequently as business priorities change over time. The Investment Phase defines the investment opportunities based on the shortfall impact (step 8.1) and

selects those that have sufficient added value for integration into a transformation roadmap that is tightly linked to realizing the strategic and business objectives.

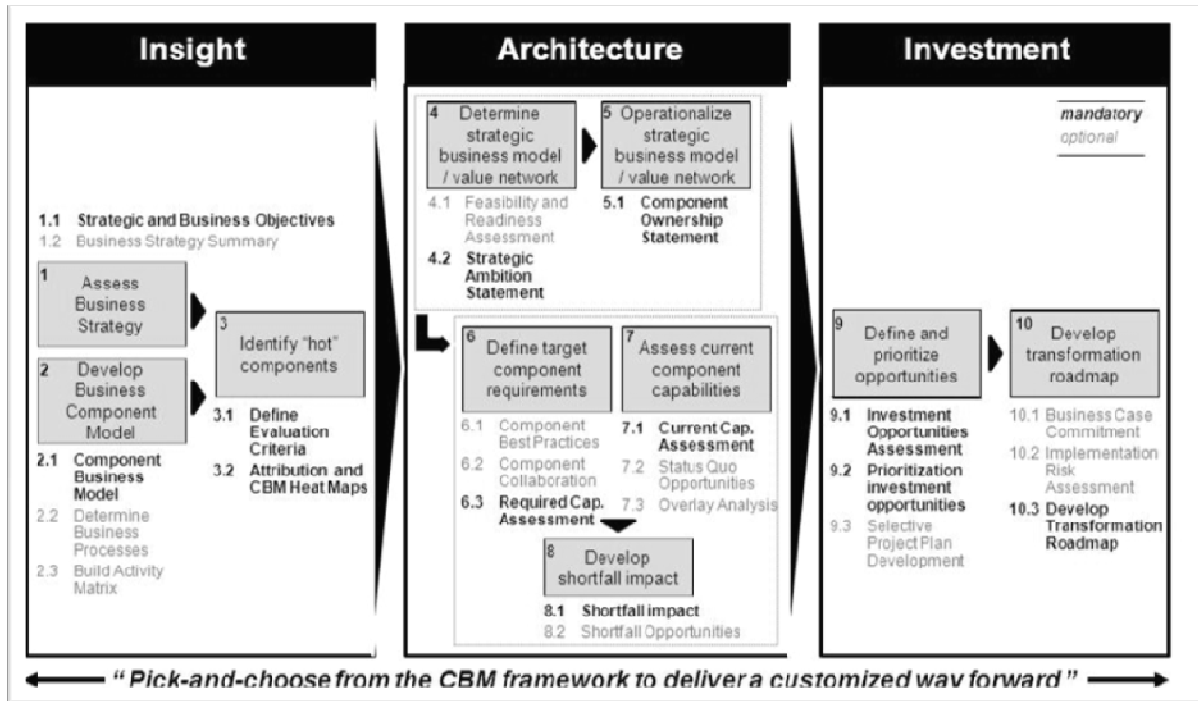


Figure 10 CBM's way of working

These three phases are consisting of ten major deliverables, which are obtained, in 24 steps. Figure 4 represents a summary of 3 phases with deliverables and 24 steps



#### 4.4 A comparative analysis of DEMO and CBM

From the description of DEMO and CBM, explained in the preceding paragraphs it is there is no doubt that they are both methodologies which are developed to make the modeling organizations possible. This modeling is done with intent to make the complexity of these organizations manageable, for which both DEMO and CBM offer specific tools to achieve it. In order to understand how effective these offering of DEMO and CBM are, it is of important to briefly analyze the two comparatively using their 3W's. This comparison is done with the intention of seeing what and how these two methodologies as modeling approaches can offer this research for achieving its objectives successfully.

The way of thinking of both DEMO and CBM is based at elementizing the organization of the enterprise. Or put in plainly, they are both intent on allowing the possibility of *divide and understand*.

DEMO does this by viewing the construction and operation of an organization through its lens of five axioms, hence every element of the organization be it static (e.g. actors) or dynamic (e.g. processes) must fit as a one of the components of these axioms. CBM does this through its componentized mentality which assumes that that whole of the organization can be represented as set of loosely coupled independent business components which are in fact the building block of the organization of the enterprise. The components that CBM defines must encapsulate the related activities including the people, processes, and technology according to a logical criterion. However what CBM lacks is a formal definition of this logical criterion like the five axioms of DEMO. The absence of such a formal criteria has both advantages and disadvantages. On the one hand it allows flexibility and agility for modeler while on other hand it causes inconsistency and confusion. In the light of these facts, it can be stated that CBM's way of thinking appears rather an empirical approach in the enterprise engineering discipline while DEMO is a more theoretical one.

In their *way of modeling*, while DEMO models ignores managerial issues and rather focuses on offering concise modeling concepts which can capture the construction of the organization as accurate as possible from a bottom-up point of view, the CBM models highly focuses on the functionality issues and the end result of each process which declares the top-down point of view it, hence allows it molders the freedom to incorporate external models the way they see it fit.

The way of working of the two methodologies clearly reflects their way of thinking. While DEMO starts with the analysis of all the available information and knowledge about the construction of the enterprise, CBM starts by analyzing the objectives of the enterprise.

This comparative analysis of DEMO and CBM can be summarized as follows:

**Table 6: DEMO and CBM dimensions compared**

	<b>DEMO</b>	<b>CBM</b>
<b><i>Way of thinking</i></b>	Conceptual	Empirical
<b><i>Way of modeling</i></b>	Constructional	Functional
<b><i>Way of working</i></b>	Bottom-up	Top-down

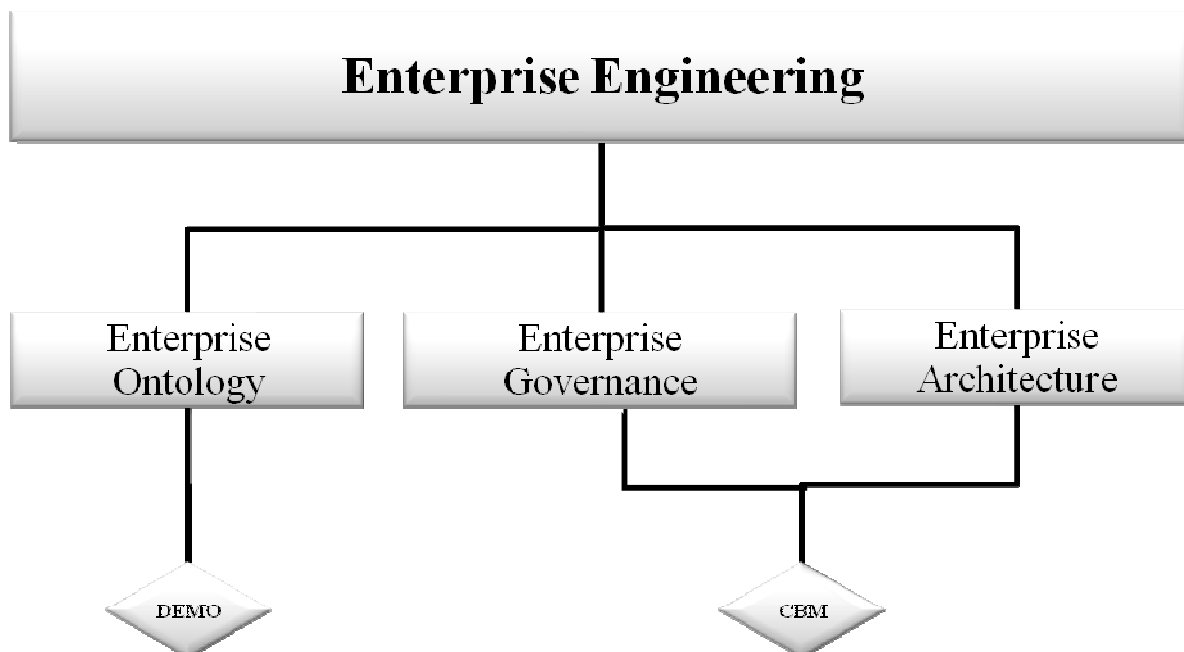
In conclusion, what is clear from the description of DEMO and CBM methodologies, and this comparative analysis is: that although both DEMO and CBM methodologies are very comprehensive modeling tools, but simply selecting one of them as the sole methodology, would not lead to the achievement of the goal of this project. This because, as stated in design requirements in paragraph 2.4 we need models which aligns functional and construction aspects of an organization without disturbing the balance between them. But while for understanding the complexity of the construction of an enterprise in a concise manner we require the theories and principles of the DEMO, for summarization and representation this complexity we need CBM's concepts.

Hence we need an approach which combines the relevant theoretical and modeling concepts of the DEMO with that of the CBM in such a way that it leads to the successful and acceptable realization of the

goals of this research, which requires a balance between bottom-up approach of DEMO and top-down approach of CBM.

#### 4.5 Recapitulation

This chapter presented a formal and compact description of two methodologies present in the emerging discipline of enterprise engineering. These two methodologies got described in terms of their 3W's (way of thinking, modeling and working). After a brief comparative analysis of them it became clear that while both of them are developed to model and organize the enterprise, they do that from two different perspectives. The primary reason for this difference is the area in the field of enterprise engineering for which they are developed. DEMO is a methodology which aims at revealing the ontology of an enterprise; hence it is trying to answer the question of how is an enterprise constructed in terms of its operations. This answer is provided at the highest level of abstraction which is fully independent of implementation level. CBM on the other hand deals with enterprise architecture and governance. Hence trying to answer the question of what does the enterprise wants to achieve and how the underlying construction of the enterprise is support that. Figure below illustrates this.



**Figure 11: DEMO & CBM with respect to three notions (ontology, governance architecture) of Enterprise Engineering**

From the comparative analysis of the DEMO and CBM it was establish the followings findings about their internal 3 dimensions:

**Table 7: DEMO and CBM dimensions compared**

	<b>DEMO</b>	<b>CBM</b>
<i>Way of thinking</i>	Conceptual	Empirical
<i>Way of modeling</i>	Constructional	Functional
<i>Way of working</i>	Bottom-up	Top-down

What also became clear is that by simply selecting one of them as the sole methodology for this project we will not be able to successfully realize the goals of the project. That reason for this laid in the fact that while for understanding the complexity in a concise manner we require the sound theories and principles of the DEMO, for summarization and representation of this complexity we need CBM's concepts. Hence

we need a mechanism or an approach which combines the relevant aspect of the theoretical and practical offerings of DEMO and CBM in such a way that it leads to the successful and acceptable realization of the goals of this research.

## 5 SBCI-method: An approach for identification of strategic focus areas

This chapter is aimed at describing the SBCI-method which is an acronym for Strategic Business Components Identifier-method. This method is a new generic and hybrid approach that is engineered to allow the representation of the organization of the enterprise in terms of its essential building blocks, in which it is possible to identify those building blocks which are of strategic relevance, in an effective manner. The realization of the SBCI-method represents the fulfillment of the first objective of this thesis project.

The SBCI-method is developed mainly through combining those elements of the DEMO and CBM, which are of relevance for obtaining an answer to the main questions of this research. Or said more concretely, the SBCI-method brings about the practical utilization of those aspects and elements of 3W's (i.e. way of thinking, modeling and working) of the DEMO and CBM through which the identification, specification and representation of the strategic focus points of an enterprise made possible. It is important to mention, that the intended practitioners or users of this method must have some elementary knowledge of the DEMO and CBM methodologies along with understanding of objectives modeling. Figure 10 illustrates how SBCI-method combines the DEMO and CBM along with their theoretical foundations which are the three important notions (enterprise ontology, architecture and governance) of the enterprise engineering discipline.

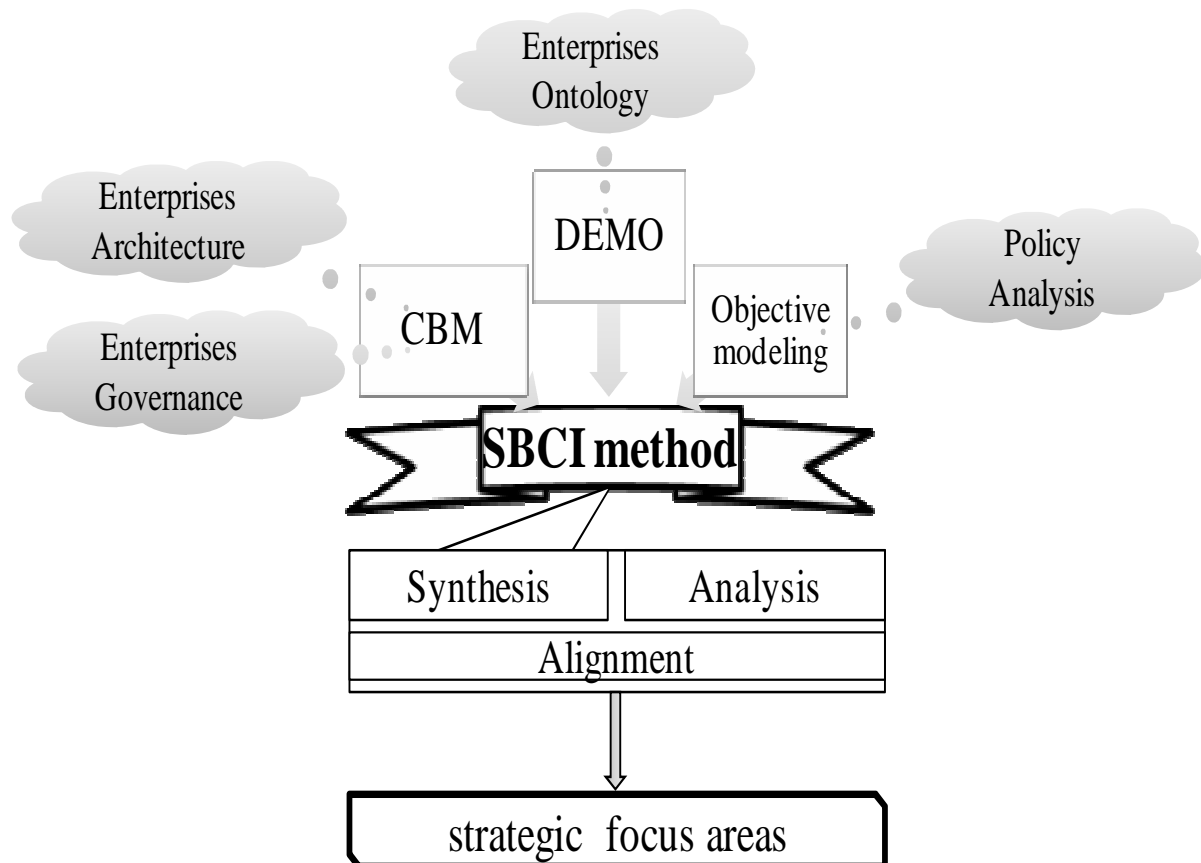


Figure 12: SBCI-method and its theoretical and methodological foundation

SBCI-method is organized along three major phases with each phase including a number of individual steps. Every step has a clearly defined input, output and activities that would bring the transformation from the given input to the required output. Table 6 illustrates these phases and steps of.

**Table 8:SBCI-method phases and steps “An approach for identifying the strategic focus areas of a domain”**

1. Synthesis phase	2. Assessment phase
1.1. Performa abilities identification	2.1. Identification of information sources
1.2. Transaction specification	2.2. Objectives categorization
1.3. Construction Model (CM) generation	2.3. Objectives structuring
1.4. Process Model (PM) generation	2.4. Objectives operationalization
1.5. Business components generation	
1.6. Required competencies specification	
1.7. CBM framework development	
3. Alignment Phase	
3.1. Linking strategic objectives to the supporting business components	

In the coming paragraphs of this chapter every step of each phase of the approach will be explained in terms of input, output and the related activities.

## 5.1 Synthesis phase

The phase includes 7 steps that are aimed at eventually represent the whole of the domain under study, as single matrix contain the essential business components which is called CBM framework. In the coming paragraphs these steps will be briefly described for a through explanation of them the reader should refer to the book of Introduction to the DEMO-methodology written by J. Dietz,[5].

### 5.1.1 Performa abilities identification

This step involves the identification of Performa abilities from the available knowledge (e.g. textual description, flow chart, etc) about the domain under study. Performa human abilities describe essential productions acts in an organization. This identification is done through application of distinction axiom DEMO. The output of this step will be a set of ontological Performa abilities.

### 5.1.2 Transaction specification

In this step the transaction axiom of DEMO is juxtaposed over the identified Performa abilities obtained in the first step of this phase. This would result to the clustering of them as *transactions types*. These transactions in return should be placed in the Transaction Result Table (TRT) of DEMO.

### 5.1.3 Construction Model (CM) generation

The transaction listed in TRT should be represented as Construction Model (CM) of DEMO. The Construction Model (CM) specifies transactions types and the associated actor roles, as well as information links between actor roles and information banks (a collective name for coordination banks and production banks). In short, the CM specifies the construction of the organization. Two models make up the Construction model (CM): the Interaction model (IAM) and Interstriction Model (ISM).

The Interstriction model (ISM) is expressed using the Organization Construction Diagram (OCD). In the Organization Construction Diagrams, one can visualize the initiator(s) and an executor for each of the identified transactions as well as the information links between the actor roles and the information banks.

### 5.1.4 Process Model (PM) generation

The transaction listed in TRT should be represented as Process Model(PM) of DEMO using the CM model generated in previous step. The PM is logical sequence of steps in which a transaction is performed. The PM should be represented through Process State Diagram (PSD)

### 5.1.5 Business components generation

This step includes the identification and generation of business components. This should be done based on the DEMO models created in step 1 to 5. The first step is the establishment of the component boundary. By boundary it means which transaction present in TRT-table should be included as activities of a single component. To establish component boundary PSD models should be used as criteria. Include all the transactions present in an individual PM as activities of the component. Table 9 illustrates a sample business component.

Table 9: A sample business component specified by CBM methodology

Name:		
Purpose		
Activity	Resources	Organization
1.		
2.		
...		
n.		
Offered services		Required services


### 5.1.6 Required competencies specification

This step includes specifying the terminologies and approaches which the subject matter experts use to define the competencies of the domain. Select an approach in consultation with subject matter experts. The output of this will be a clear terminology which describes in general terms the required competencies (e.g. value chain).

### 5.1.7 CBM-map development

In this step, place the business components generated in step 5 according to their area of competency and accountability level in the component-map (i.e. CBM framework).

A component map is a two-dimensional view of a domain. The rows of the component map represent different accountability levels which are the *Direct*, *Control* and *Execute*. Each level typically requires unique skills. The columns of the component map represent competencies and define what critical capabilities an organization needs and offers in order to be successful. Which competencies are required depends on the industry and the business strategy of the organization. The output of this step will be a CBM map of the domain under study. The figure below illustrates a CBM framework in which the required competencies specified in step 4 the components identified and generated in step 5 needs to be placed.

Table 10: Sample CBM map without components

	Required-competencies				
Direct					
Control					
Execute					

## 5.2 Assessment phase

The assessment phase is aimed at attaining the objectives. The steps of this phase deals with modeling the objectives of the domain whose constructional models constructed in the synthesis phase. The modeling is done by the identification, categorization, structuring and operationalization of them, through the usage of available theoretical and conceptual models.

Before describing the steps of this phase, it is important to clarify what is meant by objectives and why they need to be modeled? Objectives are basically nothing more but the required or desirable changes of a factor [19]. Changes can be modeled by first asking what needs to be changed. In nearly all cases[19] the answer to this question comes by specifying the factor, the value of which needs to be changed (increased or decreased). However only this not enough, in order to get the objectives formulated precisely not only the direction of the change is needed but also the particular extent of the change needs to be specified. The following equation represents a generic model for specifying an objective:

$$\text{Objective} = (\text{goal variable, direction, goal parameter})$$

In this equation the *goal variable* corresponds to the factor that must change, the *direction* indicates the nature of the desired change and the *goal parameter* indicates the extent of the change.

This equation like model is a conceptualization of an objective and has the advantage of a clear structure which helps the formulation of the objectives in a very exact fashion. However it is important to mention that in practice, gaining the values for the parameter of such a conceptual model of objectives is not always easy. This is because objectives are inclined to be clumsily defined in normal parlance and the real job of formulation of objectives lies in distilling a collection of clearly defined objectives from very sloppy formulations.

### 5.2.1 Identification of informational sources

In this step the sources which can reveal information about the objectives needs to be analyzed. The key input or sources include policy documents, senior management interviews, and senior management workshop. The

#### Activities:

1. Analyze the possible sources of information which deals with objective related issues.
2. Assess the availability, accessibility and quality of information within the list of sources.
3. Select from the listed of sources of information from which objectives can be extracted based on the availability, accessibility and quality.

### 5.2.2 Objectives categorization

This step involves categorization of the information available the selected sources regarding the objectives into the following categories:

1. **Strategic objectives:** These provide guidance for overall future *vision*.

It is very important to fully understand the strategic objectives, since they are remain stable in the course of the coming 5-10 years. Broad and long-term policies to reduce flood risk should build with recognition of these strategic objectives.

2. **Business objectives:** Guidance for specific major *decisions* over medium to long term.

The successful achievement of the strategic objectives directly depends upon accomplishment of underlying business objectives. These objectives directly influence the probability for success on the strategic objectives. We have split the business objectives into three groups. Each group consisting of business objectives related to the particular strategic objectives.

3. **Means objectives:** Guidance for specific major *decisions* over short term.



### 5.2.3 Objectives structurization

Once the objectives are categorized according to the three categories mentioned in the previous step (step 2.2) they should be placed inside a scheme which will allow a means-end application for the three categories mentioned above. Here we used objectives-tree as a modeling tool, to obtain this means-end application of the three categories of objectives. In this tree the overall mission is Figure below illustrates how an objectives-tree allows the structurization of objectives.

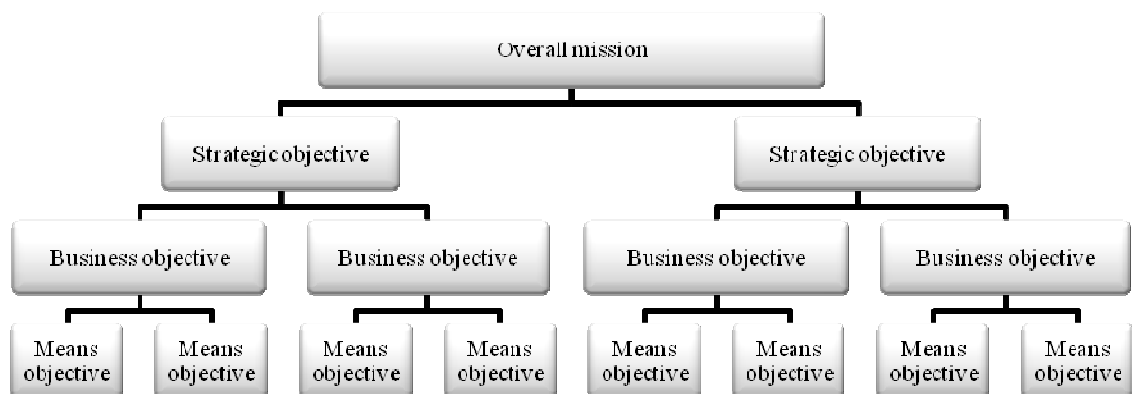


Figure 13: An example objective tree presenting the three levels of objectives

### 5.2.4 Objectives operationalization

In this phase operationalization of means-objectives or in other words operationalization of the lowest level objectives is performed. By operationalization of the means-objectives we mean the attachment of a measurement criteria and unit to the means objectives through which their extent of change increase or decrease can be calculated.

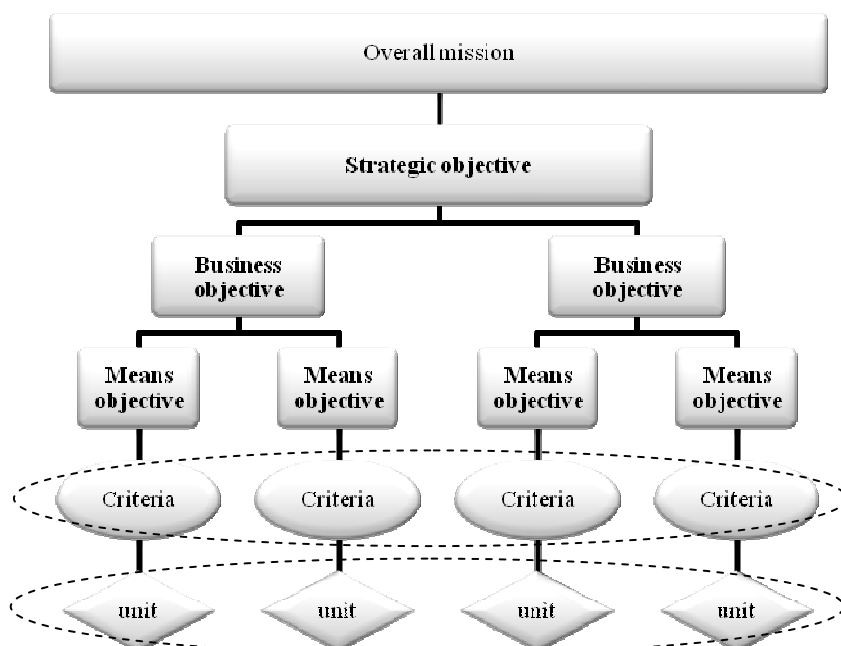


Figure 14: Objectives operationalization

### 5.3 Attribution Phase

This phase includes alignment of objectives modeled in the second phase to the business components present in CBM map which got generated in the first phase. The result of this mapping will be identification of those business components which attribute to the achievement of the strategic goals. The identified components will be called “Hot component” and the CBM map which contains them the “Heat map”. This phase ensures that future investment in processes, systems and organizational change is in alignment with the strategic objectives.

#### 5.3.1 Linking objective to the supporting components

Unlike the previous phases (Synthesis and Assessment) this phase does not require any external information as input it only needs as inputs the CBM map continuing the identified business components and the objective tree. The final output of this phase is a CBM map in which the components that will have an effect on achievement of the strategic objectives are marked as hot components

The mapping works as follows:

1. Map the low level business objective present in the objective tree to the related business components that relate and support to the them
2. Mark the linked components as hot components
3. Verify the mapping with subject matter experts.

### 5.4 Recapitulation

This chapter presented the description of a SBCI-method which is a hybrid approach, engineered to bring about the generation of a model of an enterprise in which the identification and representation of the strategic focus points is possible

This engineering of the approach proved the achievement of the first objective of the thesis project. The realization of the SBCI- method is a direct consequence of the utilization of the principles, theories and modeling techniques offered by DEMO and CBM methodologies along with objective-tree tool of Policy analysis.

Figure 13 illustrates how and where these methodologies and tools were utilized in this approach.

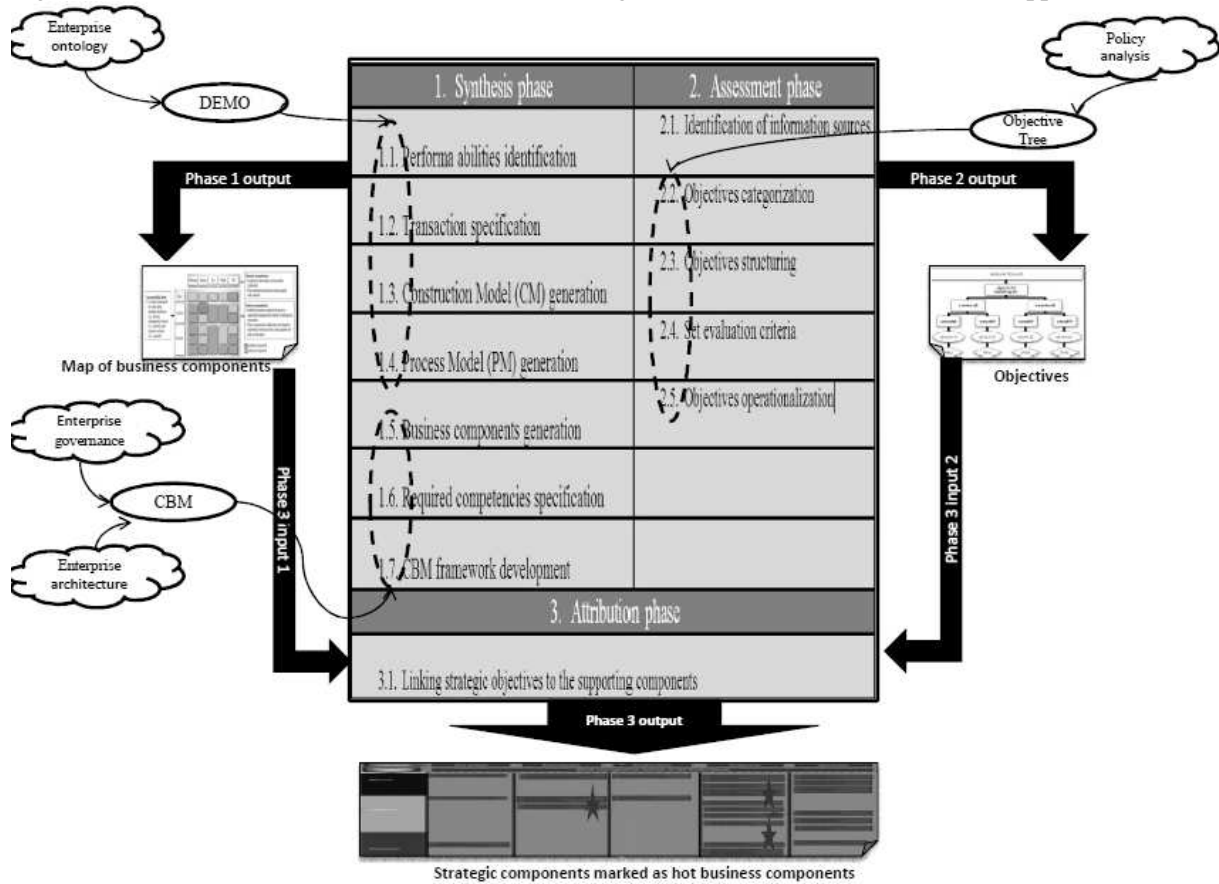


Figure 15: Summary of SBCI-method

In the paragraphs of this chapter we described SBCI-method consists of 3 phases Synthesis, Assessment and Alignment. The Synthesis phase basically involves the development of a constructional model of the system, which is expressed as a CBM-map of business components. The Assessment phase includes steps that deal with the modeling of the objectives; the ultimate output of this phase is a full categorization and operationalization of the objectives of the domain using the objective-tree as the model. The Alignment phase which is rather trivial compared to the Synthesis and Assessment phase includes mapping of the objectives modeled in the second phase to the business components present in CBM-map which got generated in the first phase. The result of this mapping will be identification of those business components which attribute to the achievement of the strategic goals.

## 6 Application of the SBCI-method

This chapter describes the application of the SBCI-method in the flood control domain of the Netherlands. The result of this process will have a twofold effect for this project. Firstly and most importantly through this application it is expected to obtain the answer to the first and second thesis questions which as stated in paragraph 2.2 were:

- 1 What are the essential building blocks of the flood control domain in the Netherlands?
- 2 Among these essential building blocks which are of the strategic relevance for the objectives of the flood control domain?

Secondly this application offers us the degree of the applicability of the SBCI-method in practical situations.

The implementation process starts with the synthesis phase. The input for the synthesis phase will be the description of the flood control domain in terms of safety, chain which got presented in chapter 3. This description was made by possible work of Diana Mongula [3] which was done in a very comprehensive and accurate manner as part of her master thesis work. Using this information as the point of departure it is anticipated that through the application of the 7 steps of this phase the development of CBM-map containing the essential business components of the domain will be possible.

After the completion of the Synthesis phase the Assessment phase starts. For this phase the National Water plan (NWP) [20] will be used as the sole input, again like the synthesis phase it expected that through the application of the 4 steps of this phase, the construction of an objective-tree will be possible which will fully operationalize the objectives set out for the domain by the authorities that made the NWP. Finally using the output of the first phase which is a CBM-map of business components and the objective tree of the second phase, the strategic focus points of the domain will be identified. These will be represented as the set of components which have a direct contribution to the achievement of the strategic objectives; all of this will be done in the Alignment phase of SBCI-method.

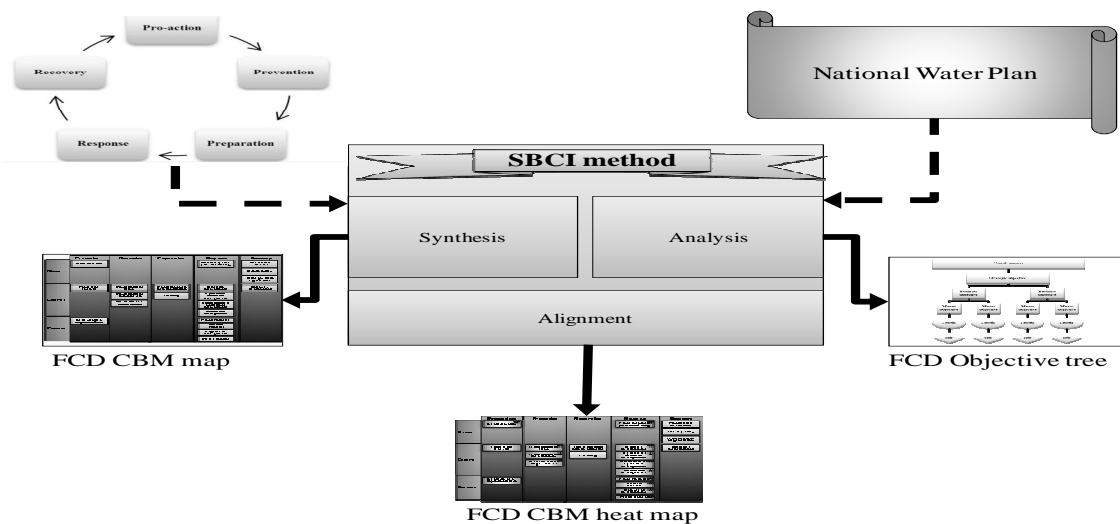


Figure 16: SBCI-method applied in flood control domain in the Netherlands

Figure 14 gives an illustration of how the SBCI-method will be implemented in flood control domain and what are the external informational inputs and what are the outputs of each phase.

The paragraphs and subparagraphs of this chapter are organized in terms of the phases and steps of the SBCI-method's implementation in the domain. In the coming paragraphs this whole process will be described. However some of the details which made readability difficult are moved to the appendix A of this document.

## 6.1 Synthesis Phase

The phase will illustrate the application of 7 steps of synthesis phase of SBCI-method in flood control domain. These steps illustrate the whole process through which the whole of flood control domain in the Netherlands got summarized as a map of business components. For the readability purposes in steps 1 to 5 only the details of the implementation in the pro-action link are given. The details for the remaining four links can be found in Appendix A of this document and master thesis work of Diana Mongula [3]. From step 6 onwards all the 5 links of the safety chain are illustrated.

### 6.1.1 Identification of Performa abilities

The input for this phase is the entire available knowledge about the flood management domain. For the flood control domain this knowledge is provided through a textual description in terms of five links (i.e. pro-action, preparation, prevention, response and recovery) of safety chain concept.

The text below shows the application of distinction axiom of DEMO which leads to identification of Performa abilities. The identified Performa abilities are underlined text.

#### Pro-Action

The water boards in the Netherlands are required every six years to provide a report of the possible future flooded areas and about their spatial plans [2]. In order to provide such a report, they perform flood analysis. The result of flood analysis is a report, which can aid in the formation of a map, showing the possibility of flooding in certain areas, for instance in the coming 100 years. Among the data that the water boards need to perform flood analysis include the following: the average rainfall data obtained from the Royal Dutch Meteo Institute (KNMI), elevation data that is obtained from Rijkswaterstaat and the internal data that comes from the water boards themselves such as different flooding scenarios.

Based on flood analysis, the Water boards develop spatial plans. Spatial plans are one of the measures that can be taken to reduce the risk of flooding and protect water resources. Spatial measures address land use, and exclude the construction of built-up areas in sensitive locations and changes in land use so that the area can also be used as an artificial water basin, etc., when necessary. For making spatial plans, the water boards also gets inputs from the European Commission located in Brussels and from the Ministry on the policy issues that should be taken into account.

The water boards send their reports to the municipalities and the provinces. These authorities use the water board's reports to make land use plans. Land use authorities: the municipalities, the provinces or the national government can initiate land-use change, for example, the development of urban areas, infrastructures, or natural environments. In order to implement land use change, the initiator has to develop a land use plan. Among the things needed to assess a land-use plan is the Water Assessment Test (WAT). The WAT is a general framework for assessing land-use proposals. The WAT framework consists of a checklist and a clarification of the roles of the actors involved. The framework includes all relevant water management aspects (flood protection, water quality and depletion). A WAT has three types of actors: the initiator, the advisor and the reviewer [9].

The initiator is the land-use authority that wishes to implement a land-use change, for example, the development of urban areas, infrastructures, or natural environments. This can be a local, regional or national authority. As already mentioned, this can be the municipality, the province or the national government. However, the initiator can also be a private organization. In such cases, the responsible public authority (municipal, provincial or national) performs the WAT.

The advisor is the water authority with jurisdiction: the water board, groundwater authority or national Rijkswaterstaat. The water authority assists the land use authority in conducting the water assessment test. If water management priorities (collect, store, and discharge) cannot be realized, explanations must be provided and compensatory measures taken. The water authority proposes mitigation and compensation measures that can be taken. The water authority then advises the land use authority on how the water management aspects can be incorporated. However, it is the responsibility of the land use authority to decide whether to incorporate the proposed mitigation and compensation measures.

The land use decision then has to be reviewed according to urban and regional planning legislation. For example, the provincial authority reviews land-use decisions taken by municipal authorities. Finally, the land use authority can implement the land use plan.

### 6.1.2 Transaction specification

The ontological abilities identified in the previous step for the pro-action phase are now formulated as transactions patterns using the transaction axiom of DEMO, the result of which is shown in the Transaction Result Table (TRT) below:

**Table 11: The TRT of the Flood Control Domain (Pro-action link) Source [3]**

TRANSACTION TYPE	RESULT TYPE
T01 Flood analysis check	R01 Flood analysis check for period P has been done
T02 Perform flood analysis	R02 Flood analysis FA has been performed
T03 Develop flood control spatial plan	R03 Flood control spatial plan SP has been developed
T04 Determine land use change	R04 Land use change for period P has been determined
T05 Develop land use change plan	R05 Land use change plan LP has been developed
T06 Advise water management related aspect	R06 Advice for water management aspect regarding land use change plan LP has been provided
T07 Assess water management aspect	R07 Water management related aspect regarding
T08 Propose water management compensation – mitigation measure	R08 Water management compensation-mitigation measure regarding land use change plan LP has been proposed
T09 Review land use change plan	R09 Review for land use change plan LP has been done
T10 Implement land use change plan	R10 Land use change plan LP has been implemented

The same procedure is followed for the other four phases (Prevention, Preparation, Response and Recovery). The details of them can be found at [3].

### 6.1.3 Construction Model (CM) generation

This step includes generation of models representing the construction of the domain in terms of the identified transactions. This is done using Organization Construction Diagram (OCD). The OCD of the flood control domain for the pro-action link of safety chain is as follows:

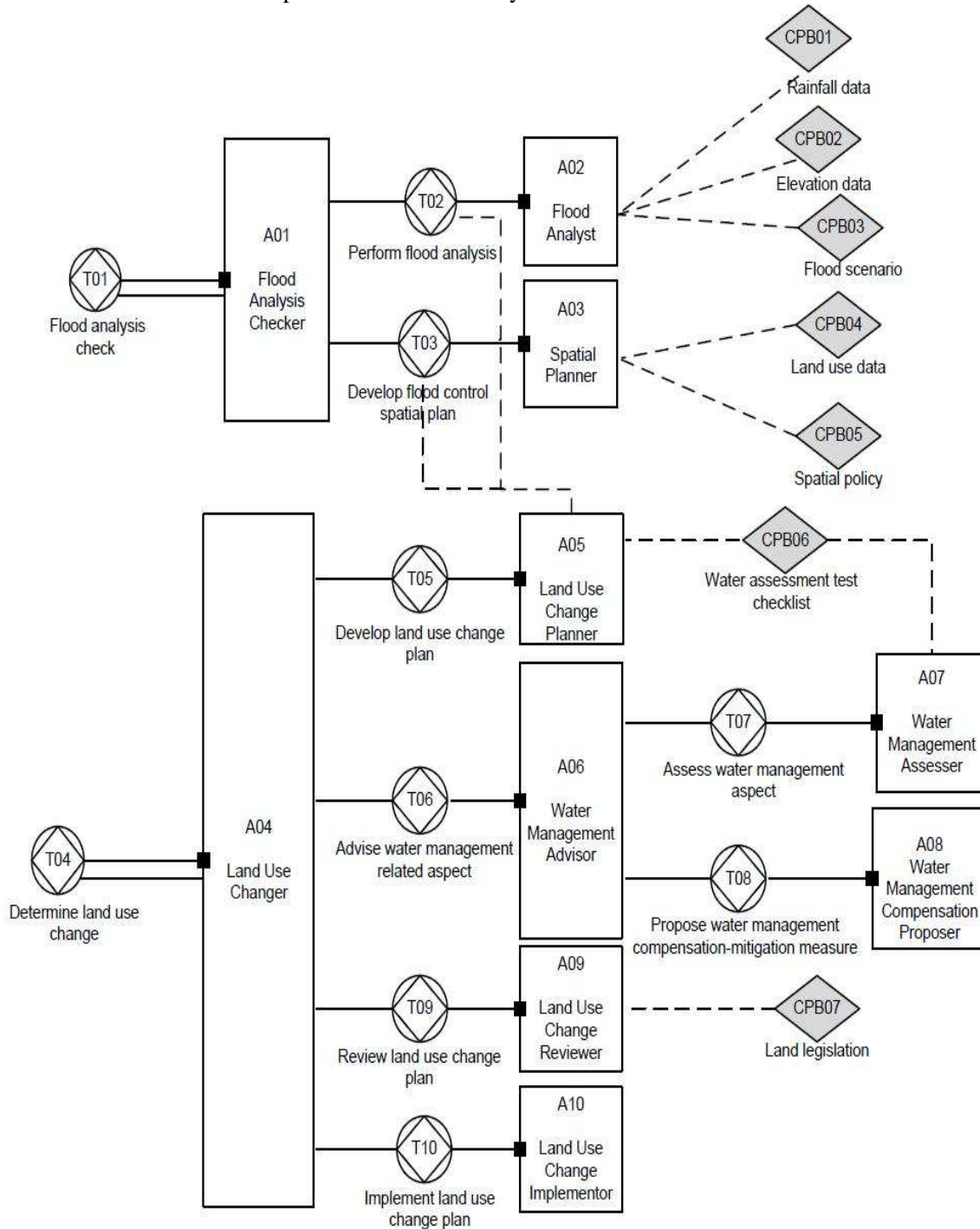


Figure 17: The TRT of the Flood Control Domain (Pro-action) Source: [3]

### 6.1.4 Process Model (PM) generation

Now that construction (OCD) and operations (TRT) of the domain are specified it is time to provide an illustration of the interrelations between these operations. The OCD diagram below illustrates that.

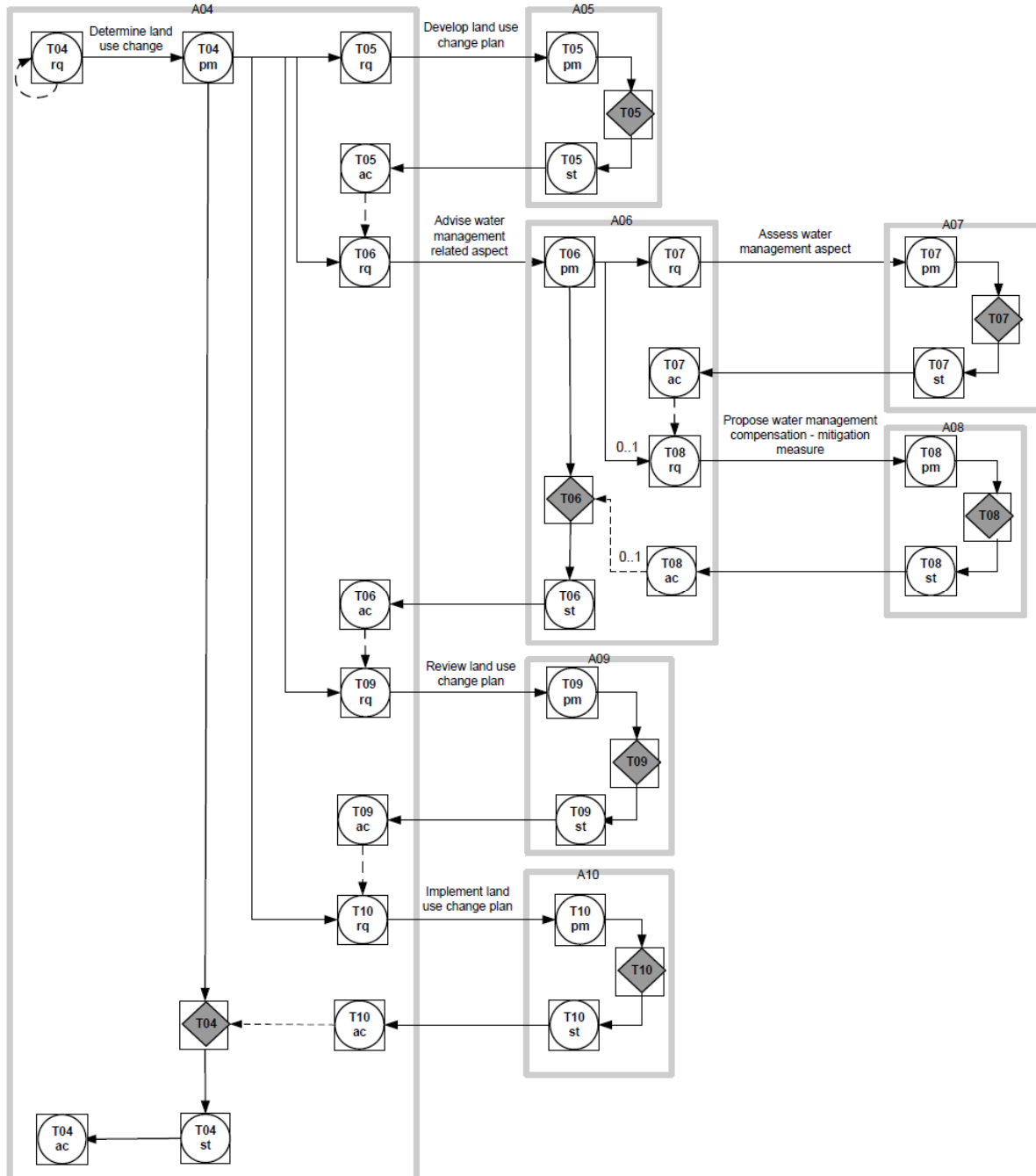


Figure 18: OCD of the Flood Control Domain (Pro-action) Source [3]



### 6.1.5 Business components generation

In this step the information available in the PM is converted as 3 dimensions (Activities, Resource and Organizations) of a business component. The Offered and Required services are beyond the goal of this work. The aim is to fill in the information in the following empty sample of a business component.

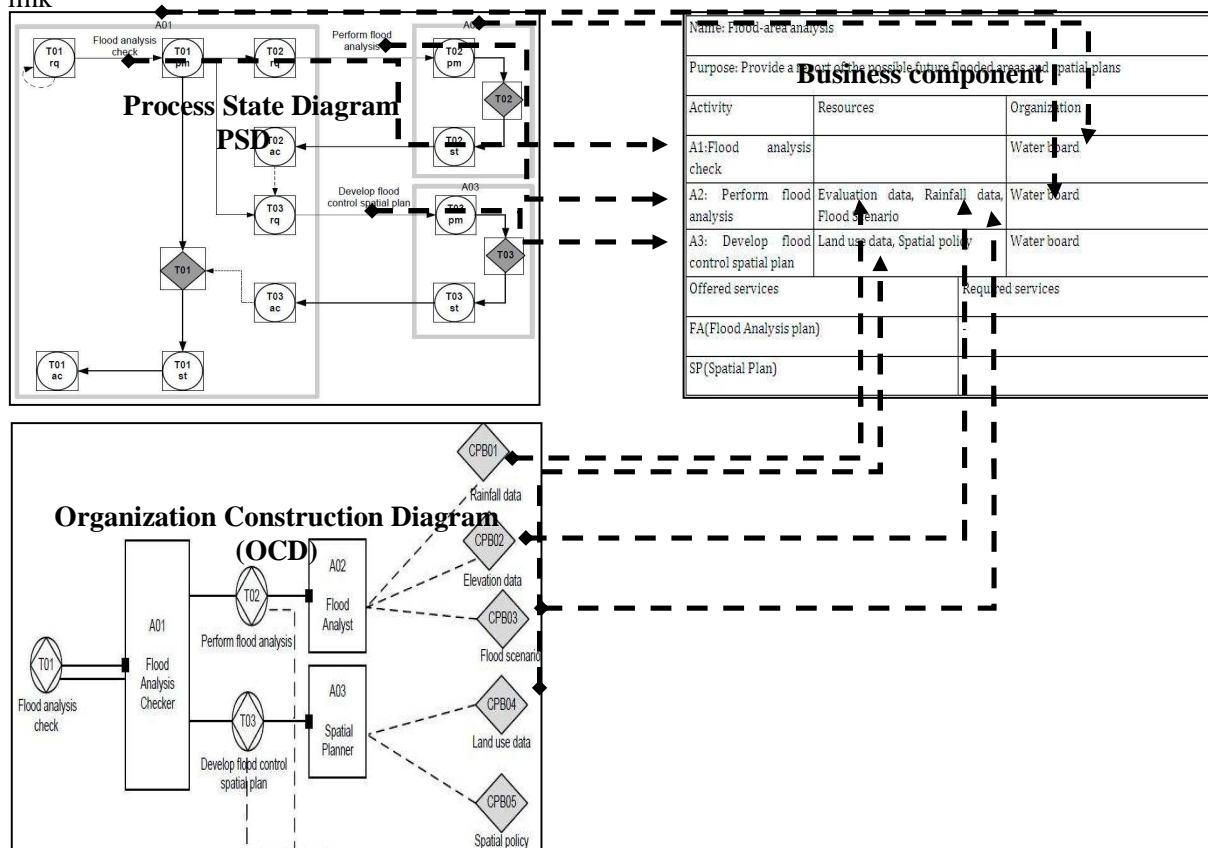
**Table 12: Sample business component**

<b>Name</b>		
<b>Purpose</b>		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
<b>Offered services</b>		<b>Required services</b>

The conversion takes place as follows:

1. For every PM model :
  - a. Place the transactions present in the PM as activities of the Business components
  - b. Place the production banks mentioned in CM as the resource needed by the corresponding activity.
  - c. Place the result of transactions as the offered services of the component.
  - d. Place the actor that executes the transition as the governance column corresponding to the activity.
2. When all the transactions in the PM are placed in the component go to the PM model and perform all the activities mentioned above.

The figure below gives an illustration of the above mentioned process for one component of the pro-action link



The business components that are generated as a result of the process shown above are as follows:

<b>Name: Flood-area analysis</b>		
Purpose: Provide a report of the possible future flooded areas and spatial plans		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1:Flood analysis check		Water board
A2: Perform flood analysis	Evaluation data, Rainfall data, Flood Scenario	Water board
A3: Develop flood control spatial plan	Land use data, Spatial policy	Water board
<b>Offered services</b>		<b>Required services</b>
FA(Flood Analysis plan)		-
SP(Spatial Plan)		

**Business Component 1: Flood area analysis for Flood Control Domain (Pro-action)**

<b>Name: Land-use strategy</b>		
Purpose: Develop a Land-use plan and an advice on water management, compensation and mitigation measures		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1:Determine Land-use change		Local governments
A2: Develop Land-use change plan	Water assessment test checklist	Local governments
A3: Advice water management related aspect		Local governments
A4: Assess water management aspect		Local governments
A5: Propose water management compensation mitigation measure		Local governments
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component 2: Land-use strategy for Flood Control Domain (Pro-action)**

<b>Name: Land-use implementation</b>		
Purpose:		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A6: Review Land-use change plan	Land legislation	Provincial and national government
A7: Implement Land-use change plan		Local governments
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component 3: Land-use implementation for Flood Control Domain (Pro-action)**

The complete list of the business components of the flood control domain of the Netherlands for five links of the safety chain are as follows:

**Table 13: Business component for flood control domain according to links of safety chain**

<b>Component name</b>	<b>Purpose</b>
<b><i>Pro-Action</i></b>	
Flood area analysis	Provide a report of the possible future flooded areas and spatial plans
Land use strategy	Develop a Land-use plan and an advice on water management, compensation and mitigation measures
Land-use implementation	Implement the land use plan
<b><i>Prevention</i></b>	
Flood defenses safety	Safety assessment of the primary flood defenses that is conducted every 5 years
Flood defenses maintenance	Maintenance of the flood defenses
Flood defense improvement	Improvement of the flood defenses
<b><i>Preparation</i></b>	
Flood response plan monitoring	Checking of a flood response plan to ensure that it is up -to date.
Training	Training of individuals and organizations within the Flood Control Domain
<b><i>Response</i></b>	
Traffic control	Traffic monitoring during evacuation implementation
Evacuation check	Checking to whether an evacuation of the population in the potential flooded area is needed.
Evacuation management	Preparation for evacuation implementation
Economic Damage Evaluation	Economic flood damage evaluation
Causality management	Casualty flood damage evaluation
Inundation management	Check the possible flooded areas and possible flood break time
Operational resources management	Check the operational resources (personnel and equipment) that are used for flood fighting activity
Flood defense operations management	Manage and monitor the flood defenses to ensure proper operation continuity disregarding the flood threat.
High water management	Operational high water management (i.e. controlling high water)
Flood Forecasting	Flood forecasting which is done at least twice a day
Weather Forecasting	It concerns the weather forecasting which is done normally every hour.
<b><i>Recovery</i></b>	
Recovery management	Recovery operation of failed flood defense
Damage claim organization	Organizing of damage claims
Return policy	Check the return of the evacuated population
Flood crisis evaluation	Checking of flood crisis evaluation.

### 6.1.6 Required competencies specification

This step includes the *selection* and *specification* of a terminology which is comprehensive of the required competencies of the flood control domain. The required competencies of the flood control domain are represented using the safety chain concept which is described in chapter three.

### 6.1.7 CBM map development

Now that all the components of the flood component domain are generated it they should be placed in the CBM map of the domain which is a single page two dimensional maps of components, whose columns represent the individual phases of safety chain and row the accountability level. In this case since the description of the initial information is provided in terms of safety-chain concept the components are straight away place in their responding column the only point which needs to be taken into account is the right level of accountability.

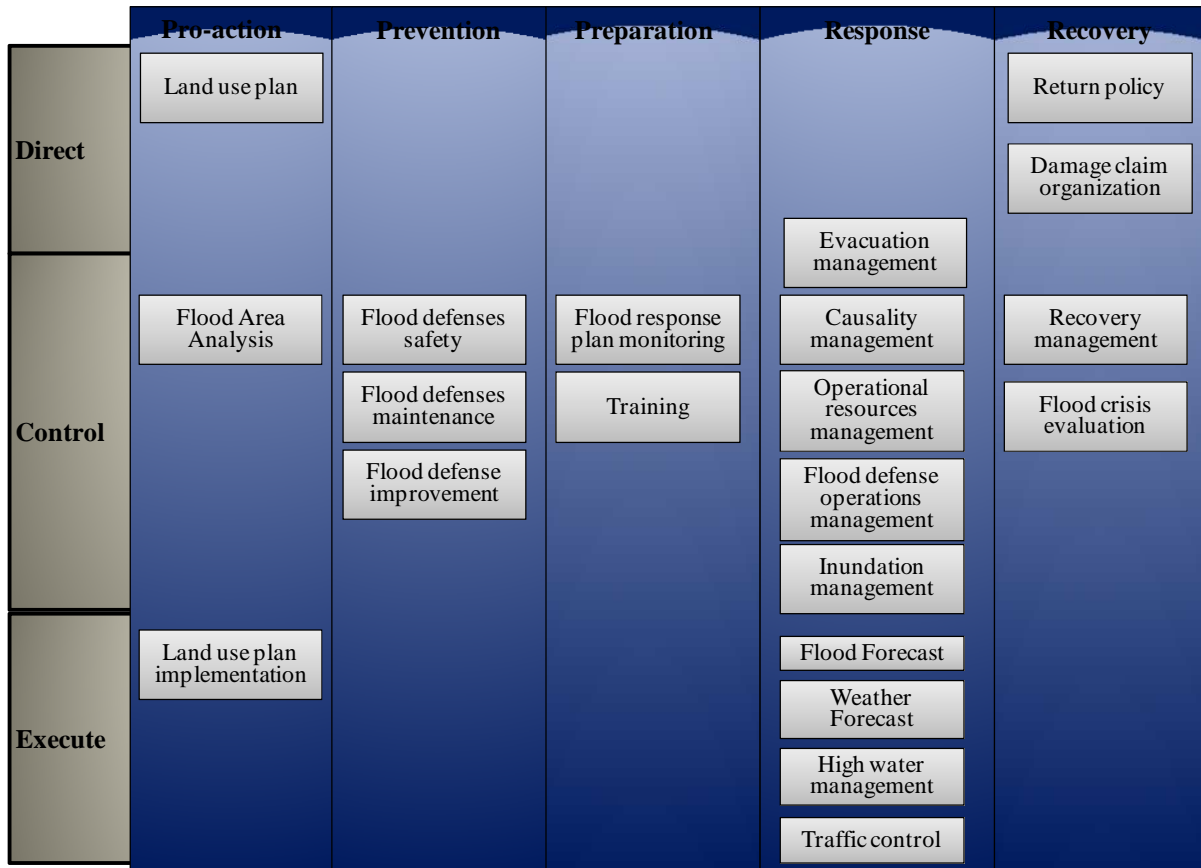


Figure 19: CBM-framework of the flood control domain in the Netherlands

## 6.2 Assessment phase

### 6.2.1 Identification of informational sources

For identification of the objectives of the flood control domain, we decided that the most reliable source of information which can reveal the objectives laid among the policy documents of the national government, for the flood control domain of the Netherlands, the most important policy document is called: “*Het Nationaal Waterplan*” (NWP)[20].

This is a policy document which outlines the vision of Dutch government for water domain in the Netherlands from the point of view of national government through their Ministry of Transport and Water (RWS), Ministry of General Affairs (VROM) and Ministry of Agriculture, Nature and Food Quality (LNV). NWP states its view point in five themes which are:

1. Water safety
2. Water shortage and supply
3. Water nuisance
4. Water quality
5. Water usage

For this project naturally the information available in the Water safety theme is of relevance. Additionally statements from individual water managers (i.e. Rijkswaterstaat and Water boards) were also used to augment confirm and clarify the information extracted from NWP policy document. The choice of NWP as the official source of information lay in the fact that this comes from the most authoritative source which is the national government and hence includes the lowest amount of subjectivity which is usually attached to objective related information sources.

### 6.2.2 Objectives categorization

Having selected NWP as the sole official source of information for obtaining the objectives of the flood control domain, in this step we will try to categorize the information available about the objectives into the following three categories:

**Strategic objectives:** From the NWP, three strategic objectives for the flood control domain were identified which together define the overall vision of national government for domain. It starts in a natural sequence from *prevention* to *spatial planning* to *disaster management*. This sequence is also referred to as a three phase approach [20].

The three strategic objectives extracted from the NWP for the flood control domain are listed in table below.

Table 14: Strategic objectives of flood control domain in the Netherlands

Strategic objectives	Description
<i>Prevention</i>	Reduce or prevent the detrimental effects of flood waters
<i>Spatial planning</i>	Creation of a sustainable spatial layout of the Netherlands
<i>Disaster management</i>	Improve the organization preparedness for disasters mitigation incase of potential flood events

**Business objectives:** The business objective which would lead to the realization of the above mentioned three strategic objectives is not yet fully specified since the NWP is still a work in progress. From the current status of the NWP only the following business objectives could be extracted

Table 15: Business objectives of flood control domain in the Netherlands

Strategic	Business objectives
<i>Prevention</i>	Strengthened costal defenses
	Dike strength
	Spatial measures in river areas

<i>Spatial planning</i>	
<i>Disaster management</i>	Better cooperation among water agencies

As can be seen only the business objective relating to the Prevention is mentioned. Spatial planning Disaster management is not still a work in progress.

The importance of business objectives are for understanding the preferences for specific actions. This step suggests that the *business* objectives are much more complex. We also recognize that the water managers will have to consider tradeoffs between these objectives when considering possible courses of action. Thus, the *business* objectives are an important input into assessing what might be called a “utility function” that reflects their preferences among attack modes and targets. A utility function, in turn, can be used as an input to assess the likelihood of future actions.

**Means objectives:** Since the business objectives are not yet formally defined it is very logical that the means objectives which lies on level lower than them are not present yet.

Hence from this step it can be unfortunately concluded for flood control domain we will be only having the strategic objective at our disposal and need to work without business and means objectives for the time being.

### 6.2.3 Objectives structurization

Having compiled the list of objective related information from the sources described above, they are positioned according to their category in the objective tree shown below. The objective tree below illustrates an overview of the organization and interrelationships of these objectives.

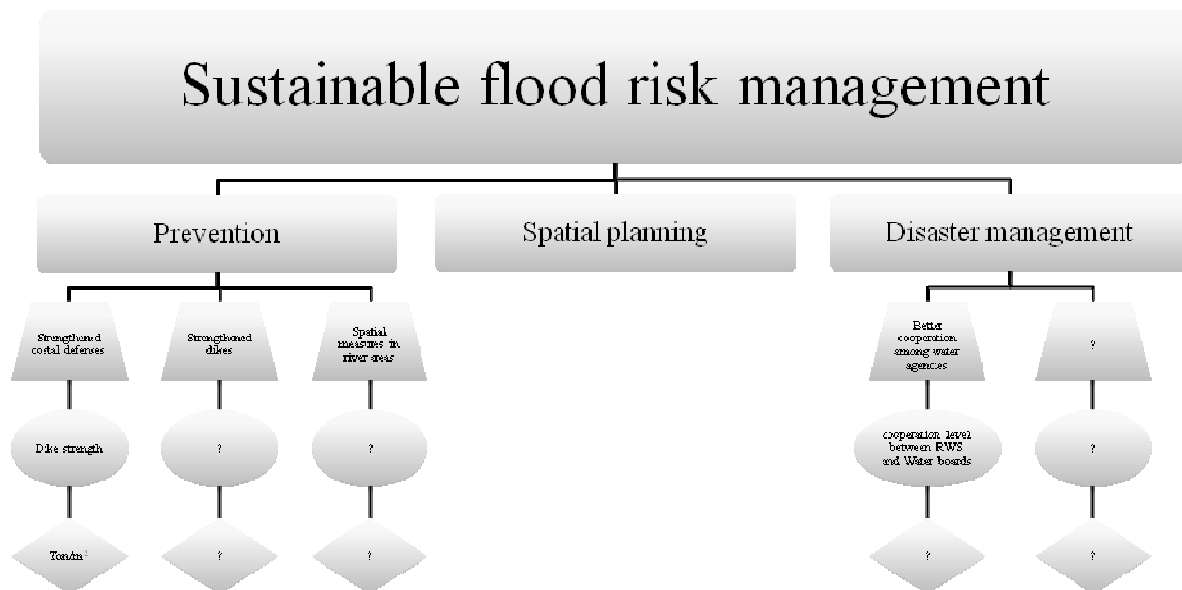


Figure 20: Objective tree of flood control domain, Source: National Water Plan [20]

As can be seen this objective tree presented in figure 20 is incomplete. This because as mentioned in step 3 of this phase of the implementation work, the work in progress status of the NWP prevent us from filling up the complete tree. This also leads to the skipping the last step of this phase which is the Objectives operationalization. Since this step is purely based on the availability of the means objectives.

### 6.3 Alignment-Phase

#### 6.3.1 Linking objective to the supporting components

Formally said this phase is aimed at the aligning of the components present in the CBM map of the flood control domain which is developed in Synthesis phase to the low level objective of the objective tree which was attained in the Assessment phase based on the information available in NWP. This is done with the intention of identifying the components which have a direct contribution to the successful realization of the strategic objectives of the domain. In phase there is not external information like safety chain description of the flood control domain or the NWP is used, but rather the internal outputs of the first and second phases of the SBCI-method.

The outputs of the Synthesis and assessment phase are as follows:

- CBM map of business components of the domain

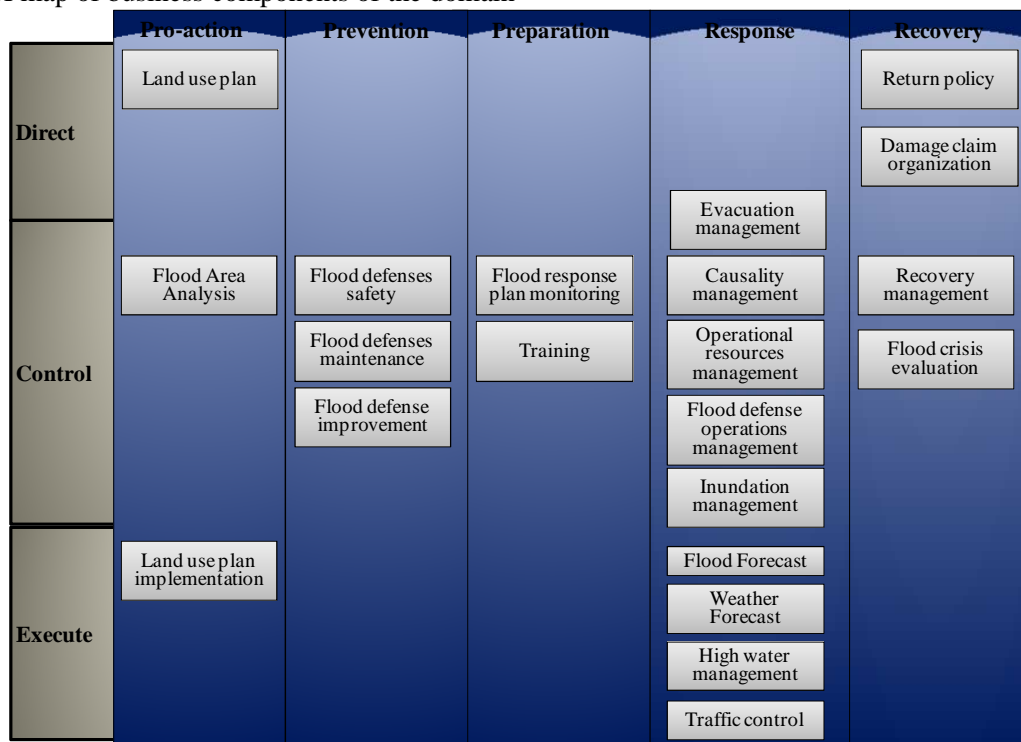


Figure 21: CBM map of the flood control domain

- Objective tree of the domain: This represents the information available in the NWP document, which was the constructed in the analysis phase we had the 3 strategic objectives:



**Figure 22: Strategic objectives of the flood control domain set out by the NWP**

Since the underlying business and means objective is still work in progress and not yet officially specified we are left with the only choice of having to deal with the formally mentioned objectives and therefore the mapping will also lead to areas of strategic focus rather than exact strategic points or components.

The mapping of the strategic objectives of the flood control domain the CBM-map of the domain let to the identification of focus areas highlighted in figure X. From the figure we are able to answer the second question of the thesis that strategic focus are of the flood control domain according to NWP can be divided into three areas with each area represented in terms of business components that it encompasses:





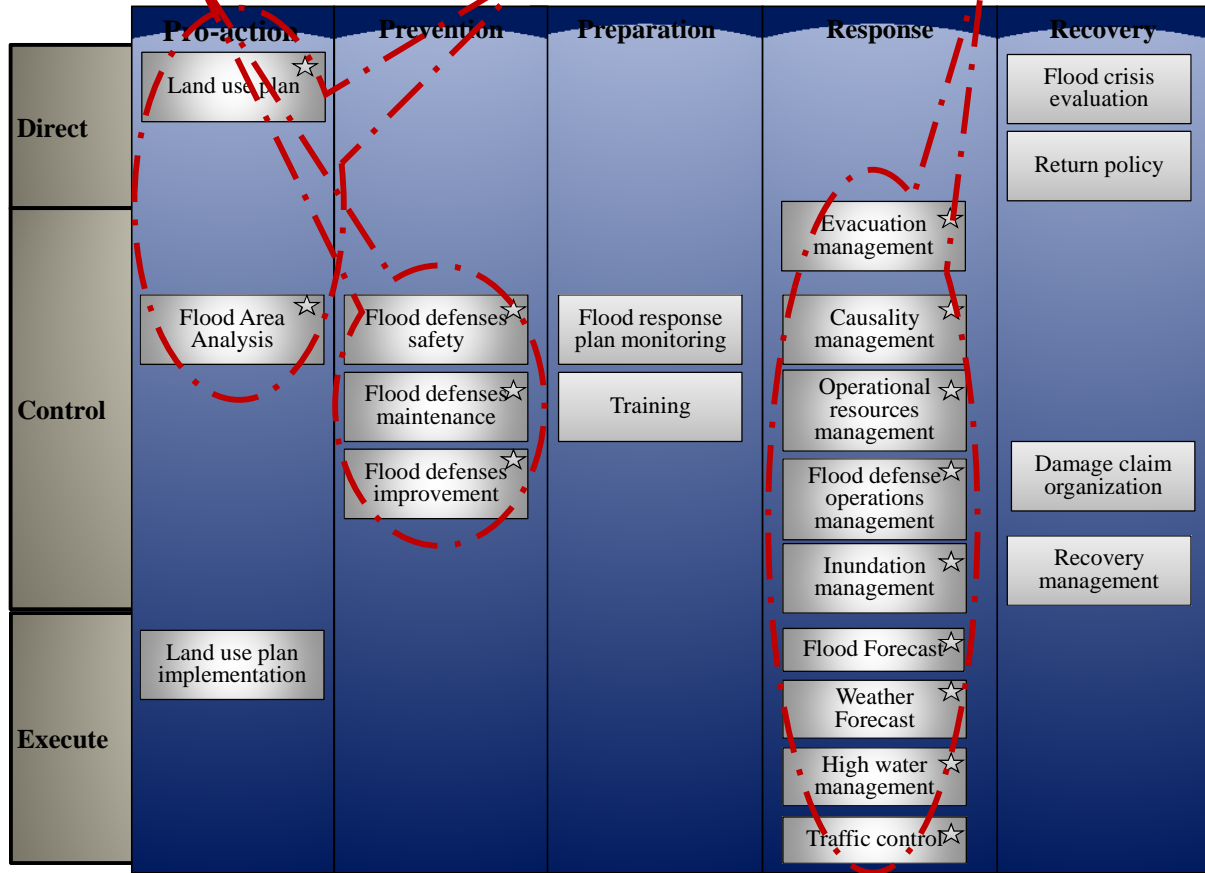


Figure 23: Linking the strategic objectives to the CBM map of the flood control domain

## 6.4 Recapitulation

This chapter presented the implementation of the SBCI-method in the flood control domain of the Netherlands. Through the performing of the 7 steps of the first phase (i.e. Synthesis) of this process it was able to establish that there are 23 essential building blocks which form the backbone of the flood control domain in the Netherlands. These building blocks got represented as business components and placed in the CBM-map based on their competency area and accountability level. Once this was established the Assessment phase started.

In this phase National Water Plan was the input. Through the steps of this phase it was able to establish that for the flood control domain there are three strategic objectives. These objectives define the ultimate vision for the domain which starts in a natural sequence from *prevention* to *sustainable spatial planning* to *disaster management*. These are very important to understand since these objectives are likely to remain stable for a long period of time compared to business and means objectives. Although this phase intended to identify business and means objectives as well but since the NWP does not specify them yet, it was opted to work without them, rather than collecting them informally through the water agencies. This was done for the purpose of avoiding the element of subjectivity which might arise as a result of informally collecting information relating to business and means objectives. Just like strategic objectives, business and means objectives are important to capture since they let to understanding of preferences for specific actions. The application of this phase of the SBCI-method in the flood control domain suggested that the business objectives are much more complex and are many times incomplete or does not exist at all. It should also recognize that the water managers will have to consider tradeoffs between these objectives when considering possible courses of action. Thus, the business objectives are important inputs into assessing what might be called a “utility function” that reflects their preferences among modes of actions. A utility function, in turn, can be used as an input to assess the likelihood of future actions. The application concluded with the alignment of business components present in CBM-map of the domain to the strategic objectives set out by the NWP so far. The output of this phase led to specification of three strategic focus areas with each area represented in terms of business components that it encompasses.

**Table 16: List of Business components of the Flood Control Domain**

1.	Flood area analysis*
2.	Land use strategy*
3.	Land-use implementation
4.	Flood defenses safety*
5.	Flood defenses maintenance*
6.	Flood defenses improvement*
7.	Flood response plan monitoring
8.	Training
9.	Traffic control*
10.	Evacuation check*
11.	Evacuation management*
12.	Economic Damage Evaluation*
13.	Causality management*
14.	Inundation management*
15.	Operational resources management*
16.	Flood defense operations management*
17.	High water management*
18.	Flood Forecasting*
19.	Weather Forecasting*
20.	Recovery management
21.	Damage claim organization
22.	Return policy
23.	Flood crisis evaluation

\*Strategic components

In conclusion it can be argued without doubt that the application of the approach in flood control domain stepped into relatively new territory that is identification the strategic focus areas in an domain of organization using policy documents in gaining the objectives, rather than from managerial interviews

which is a common practice in decision analysis and then using these objective to identify points of focus in construction models. But this approach was indeed necessary because of multi-actor setting of the domain. Nevertheless this indirect approach of identifying and structuring values and objectives and then aligning them to the constructional models provided a first-order idea of what is expected from the flood control domain rather than what the flood control expects of itself. Figure below illustrates a summary of this whole application process.

## 7 Evaluation: Project Results Analysis

The engineering the SBCI-method and its application of in the flood control domain in the Netherlands, completed the stated objectives of this work. This chapter is going to provide an evaluation on these objectives, which will be done through evaluating every individual objective in its entirety.

### 7.1 Engineering of the SBCI-method

This was the first objective of the project which was stated as the: *Engineering of a generic approach, which allows identification, specification and representation of essential building blocks of a domain; such that the strategic focus areas of a domain can be specified in terms of these building blocks.*

This objective was extremely essential to answering the main thesis question. As have been presented in chapter 5 this objective of the project was realized though engineering of a hybrid approach which got called SBCI (Strategic Business Component Identification)-method. The engineering of this method was made possible through combining of those aspects of DEMO and CBM methodologies which were compatible with each other and were of value to the realization of the project goal. This combination was organized along the three phases (Synthesis, Assessment and Alignment) of the method. The reason behind the organization of the method along these three phases was not done just for the mere simplification reasons, but laid in the ontological point of view, which states that the organization of an enterprise exists independent of its function that is supposed to serve. Hence the objectives of an enterprise does not constitute an inherent part of it and needs to be dealt with independently. In this phase the partial enterprise ontology constructed by means of DEMO offers a pure representation of the essence of the enterprise. As a consequence, the business components which are derived from these models really and directly represent only the essential business activities and ultimately the essential building blocks at the highest level of abstraction by ignoring the unnecessary implementation details. Moreover, since the process steps present in process models of DEMO are atomic from the enterprise point of view, one can be sure to have found the finest level of granularity that needs to be taken into account for defining the boundaries of the business components. Also, one can be sure that this set of process steps is complete and minimal. That is why the steps of the Synthesis phase are organized such that they purely deal with constructional aspects of the enterprise. In the same way steps of the Assessment phase only deal with the objectives related issues or put formally with the function of the enterprise and in full isolation from the construction of the enterprise for which they are made. The steps of this phase use the well-established and proven concepts of the objective modeling paradigm offered by the [19]. The Alignment phase which is rather trivial compared to the first two phases is and includes a mapping of the outputs of Synthesis and Assessment phase.

This approach being based on the resulting models of the enterprise ontology provides an automated approach for the identification of business components defined by the CBM methodology. In using this approach, different business component models could be generated for various business and industry domains. The SBCI-method in fact offers a balance between purely top-down (e.g. CBM) and bottom-up (e.g. DEMO) approaches in the enterprise engineering discipline.

With the organization of the SBCI-method in such a manner it can be said without any doubt that it still fully inherits the 6 important qualities (i.e. Essential Consistent Coherent Complete Modular and Objective) of the DEMO methodology [14] in spite of dealing with objectives (functional) related issues, which DEMO intentionally ignores.

Hence it can be said that SBCI-method through its well thought engineering, organization and the usage of DEMO and CBM methodologies is an effective tool in the field of enterprise engineering, which allows an alignment of the three most important notions of the discipline namely enterprise ontology enterprise architecture and enterprise governance without disturbing the well laid balance among these notions.

As for the main problem owner of this project which is the IBM Global Center of Excellence for Water Management, the SBCI-method allow them to enrich the CBM methodology of IBM by using the steps of

the Synthesis phase of it to generate their future CBM-maps for various domain of industry in a much more effective manner based, and the By making the devolvement of the CBM maps based on SBCI-method's Synthesis phase their map's will automatically inherits the above mentioned 6 quality criteria. Similarly they can incorporate the steps of the Assessment phase of this method in the way of working of the CBM methodology to get much more organized and concise way of modeling the objectives of the client's problem that they want to address through their CBM methodology.

## **7.2 Application of the SBCI-method**

This was the second objective of the project which was stated as the: *The application of this approach in the flood control domain in the Netherlands with the aim of understanding where the strategic focus areas lay.*

Through the application of the SBCI method in the flood control domain it became possible to answer both first and second research questions in an effective and accurate manner which will see now.

The first research question was formulated as:

- 1 What are the essential building blocks of the flood control domain in the Netherlands?

The answer to this question came from the output of the Synthesis phase of the SBCI method. In it the all the essential building blocks of the domain got identified and represented as 24 business components. These components then got positioned in the CBM map which specified their competency area and accountability level which allowed us to call it the CBM-map of the flood control domain of the Netherlands.

The second research question was:

- 2 Among these essential building blocks, which one of them is of the relevance to the strategic objectives of the flood control domain?

The answer to this question came in as a result of Alignment phase. This phase included a mapping of the outputs of the Assessment phase to that of Synthesis phase. In the Assessment phase the objectives of the flood control domain got modeled based on the information available in the National Water Plan. However it is important to mention that in this phase we did encounter the classical difficulties of the objectives modeling which is lack of information specifying the goals. But this was already anticipated, since this is an already know problem in world of objectives modeling. In spite of this we were able to capture the three strategic objectives of the domain which are: Prevention, Spatial Planning and Disaster Management. With these in hand and the CBM-map of the domain it was able to establish that of the 23 business components which represented the flood control domain 14 of them are of the strategic importance.

In this presence of such results it will be accurate to say that this project did answer both of the research questions in an adequate way through the successful realization of the project objectives.

## 8 Conclusion and Recommendation

### 8.1 Conclusion

This document presented the research work that was conducted in partial fulfillment of the master thesis project for the degree of the MSc. in Computer Science, Information Architecture track from the EEMCS faculty of TU-Delft and executed in IBM Center of Excellence for Water Management.

This work addressed the problem of identifying the strategically relevant areas of the organization. This problem was addressed through the engineering of a new approach which utilized two methodologies of enterprise engineering discipline namely DEMO and CBM. This approach was realized in the form of the SBCI method which got as it described in chapter 5 is a method which allows the representation of the organization of the enterprise in terms of its essential building blocks, in which it is possible to identify those building blocks which are of strategic relevance.

After the engineering of SBCI-method, it was applied in the flood control domain of the Netherlands, with the intent of obtaining answers to the first and second research question. As a result of this we were able to present the whole of flood control domain as 23 business components which represented the essential building blocks of the domain, of these 23 components 14 were identified to be of strategic relevance. The application of the SBCI-method in the flood control also provided us with unintended but yet very important result which is the practical applicability of the method in real world problems.

The above mentioned results of the process got analyzed in chapter 7 which allowed us to conclude that the project realized its specified objectives in a successful manner.

### 8.2 Recommendations for future research

With above mentioned results it is correct to say that this is research did achieve its declared goal and hence is at point where it is stopped. However the outputs and the findings of this research can lead to many new research works for future researchers. The coming paragraphs will offer a number of recommendations on the extending possibilities of this work in the future.

**Recommendation 1:** *“Verification of the CBM-map along with its heat-map by the water managers whose organizations are represented in these maps.”*

In order to obtain a practical verification of the CBM-map of the flood control domain in the Netherlands and its associated heat map, in which the strategic focus areas are identified. It should be shared with the water managers whose organizations are present in these maps through a validation study or project. By this first of all these water managers gain more knowledge about the role of their organization in the domain, which also hence enhances the shared understanding of the domain and secondly it allows a practical verification of the CBM-heat maps of the domain.

**Recommendation 2:** *“Full operationalization of the objectives-tree based on the progress of NWP.”*

As we have seen in the Assessment phase of the SBCI-method presented in paragraph 6.2 it was not possible to fully operationalize the objective tree based on the information available in NWP currently. This is because the NWP document is still a work in progress [22]. However in the NWP it is clearly stated that more information will be available which will further quantify the already mentioned policies. Based on the information secured as result of the further development of NWP the objective-tree of the domain can be fully operationalized deep to the level where every means objective is clearly defined along with a measurement criteria and unit. Once this is done a mapping process can be performed, which will allow the linking of every means objective to the individual business components(s). This would

eventually lead to the identification of individual strategic business components which was the intended final output of the SBCI-method.

**Recommendation 3:** *“Mapping of the (software) application landscape to the activities of the strategic business components.”*

A mapping of the software applications currently in use by the actors of the flood control domain in the Netherlands to the operation and activities of these actors represented in the business components devolved in this work can be very valuable, because it would ultimately lead to the firstly to the identification of software applications that support the building blocks of the domain and secondly which one of them are of strategic importance to the domain. A starting point for this process can be the already available application landscape of the RWS presented in Appendix C.

**Recommendation 4:** *“Defining of the services that business components receive and offer to each other.”*

Currently the business components that are defined in this work are only defined at the level of activities resources and governing/performing organizations of these activities. The project objectives did not require the defining of the specific services that a component may offer or receive from other components. However it can be of interest for future studies to define in these services for these components in such a way that every component would represent a well-defined capability. This would allow the identification of strategic capabilities offered by the actors of the domain independent of the organizational boundaries of the actors that make such capabilities possible. This can be done through setting up of a Service System Engineering (SSE) project. As a starting point the book of the Designing Mobile Service System [21] can offer a sound theoretical material on setting up such a project.

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## Appendix A

### Componentized Flood Control Domain

FCD in the Netherlands in this document is defined in terms of actors (i.e. organizations and agencies) that are involved in activities related to flood management. These actors are specified in terms of organizations they belong to, roles they play and responsibilities that they have in water management and disaster management. The actors that form the flood management domain in the Netherlands is as follows

VenW	Ministry of Transport, Public Works and Water Management
BZK	Ministry of the Interior and Kingdom Relations
RWS	Rijkswaterstaat
WD(RWS)	Inland Water Management and Water Treatment service of RWS
DID (RWS)	Data-ICT-Service of RWS
KNMI	The Dutch weather Institute
LCO	National Flood Threat Coordinating Commission
LOCC	National Operational Coordination Centre
NCC	National Coordination Centre
DCC	Departmental Coordination Centre
ROT	Regional Operation Team
CRAS	Central Damage Registration and Reporting Point
CRIB	Central Registration and Information Bureau
NRK	The Netherlands Red Cross

From the safety-chain prospective, the above-mentioned actors are distributed as follows:

**Pro-action:** actors involved in this link include the national, provincial and local governments as well as the water boards.

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Business Component ProAction-link 2.....	71
Business Component ProAction-link 3.....	71

**Prevention:** the main actors are the water boards and the Ministry of Transport, Public Works and Water Management together with its divisions, especially Rijkswaterstaat.

Business Component Prevention-link 1.....	73
Business Component Prevention-link 2.....	73
Business Component Prevention-link 3.....	74

**Preparation:** the primary factors responsible for specifying activities in this link are the municipalities. The provinces have regulatory authority over the municipalities. The Queen’s Commissioner (in the provinces) ensures administrative coordination with and between municipalities, state services and other authorities and bodies. At national level, the Ministry of the Interior and Kingdom Relations plays a coordinating role.

Business Component Preparation-link 1.....	76
Business Component Preparation-link 2.....	76
Business Component Preparation-link 3.....	<b>Error! Bookmark not defined.</b>

**Response:** according to the Disaster and Major Accidents Act, the municipal mayors are in supreme command and, as a result, municipalities play a central role in the response link. Disaster control is initially carried out by the emergency services (police, fire brigades, medical aid). However, when the situation becomes more serious or transcends the boundaries of one municipality, provincial or even national authorities (especially the Ministry of Home Affairs) may decide to coordinate or otherwise intervene.

Business component Response-link 1 .....	79
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**Recovery:** all government authorities will play a role in recovery. However, an important role in the recovery link is reserved for the State within its financial capabilities.

Business component Recovery-link 1 .....	83
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In the coming paragraphs flood management domain is described in terms individual links of the safety-chain. First a detailed textual description of every link is given in which essential operations of the actors mentioned above are specified using the *peroformainforma* analysis of DEMO methodology. Then these operations are represented as single transactions of TRT axiom. These transactions are then grouped together according to their ... and presented as individual business components of the CBM method.

### ***Pro- action***

The water boards are required every 6 years to provide a report of the possible future flooded areas and about their spatial plans [source]. In order to provide such a report, they perform flood analysis. The result of flood analysis is a report, which can aid in the formation of a map, showing the possibility of flooding in certain areas, for instance in the coming 100 years. Among the data that the water boards need to perform flood analysis include the following: the average rainfall data obtained from the Royal Dutch Meteor Institute (KNMI), elevation data which is obtained from Rijkswaterstaat and the internal data that comes from the water boards themselves such as different flooding scenarios.

Based on flood analysis, the Water boards develop spatial plans. Spatial plans are one of the measures that can be taken to reduce the risk of flooding and protect water resources. Spatial measures address land use, and exclude the construction of built-up areas in sensitive locations and changes in land use so that the area can also be used as an artificial water basin, etc., when necessary. For making spatial plans, the water boards also gets inputs from the European Commission located in Brussels and from the Ministry on the policy issues that should be taken into account. The water boards send their reports to the municipalities and the provinces. These authorities use the water board's reports to make land use plans. Land use authorities: the municipalities, the provinces or the national government can initiate land-use change, for example, the development of urban areas, infrastructures, or natural environments. In order to implement land use change, the initiator has to develop a land use plan. Among the things needed to assess a land-use plan is the Water Assessment Test (WAT). The WAT is a general framework for assessing land-use proposals. The WAT framework consists of a checklist and a clarification of the roles of the actors involved. The framework includes all relevant water management aspects (flood protection, water quality and depletion). A WAT has three types of actors: the initiator, the advisor and the reviewer. The initiator is the land-use authority that wishes to implement a land-use change, for example, the development of urban areas, infrastructures, or natural environments. This can be a local, regional or national authority. As already mentioned, this can be the municipality, the province or the national government. However, the initiator can also be a private organization. In such cases, the responsible public authority (municipal, provincial or national) performs the WAT. The advisor is the water authority with jurisdiction: the water board, groundwater authority or national Rijkswaterstaat. The water authority assists the land use authority in conducting the water assessment test. If water management priorities (collect, store, and discharge) cannot be realized, explanations must be provided and compensatory measures taken. The water authority proposes mitigation and compensation measures that can be taken. The water authority then advises the land use authority on how the water management aspects can be incorporated. However, it is the responsibility of the land use authority to decide whether to incorporate the proposed mitigation and compensation measures. The land use decision then has to be reviewed according to urban and regional planning legislation. For example, the provincial authority reviews land-use decisions taken by municipal authorities. Finally, the land use authority can implement the land use plan.

### CBM components for pro-action link

<b>Name:</b> Flood-area analysis		
<b>Purpose:</b> Provide a report of the possible future flooded areas and spatial plans.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1:Flood analysis check		Water board
A2: Perform flood analysis	Evaluation data, Rainfall data, Flood Scenario	Water board
A3: Develop flood control spatial plan	Land use data, Spatial policy	Water board
<b>Offered services</b>		<b>Required services</b>
-		-
-		-

#### Business Component Pro-Action-link 1

<b>Name:</b> Land-use strategy		
<b>Purpose:</b> Develop a Land-use plan & an advice on water management compensation & mitigation measures		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1:Determine Land-use change		Local governments
A2: Develop Land-use change plan	Water assessment test checklist	Local governments
A3: Advice water management related aspect		Local governments
A4: Assess water management aspect		Local governments
A5: Propose water management compensation mitigation measure		Local governments
<b>Offered services</b>		<b>Required services</b>
-		-

#### Business Component Pro-Action-link 2

<b>Name:</b> Land-use implementation		
<b>Purpose:</b>		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A6: Review Land-use change plan	Land legislation	Provincial and national government
A7: Implement Land-use change plan		Local governments
<b>Offered services</b>		<b>Required services</b>
-		-

#### Business Component Pro-Action-link 3

### ***Prevention***

Without flood defenses such as dikes and dunes, more than half of the Netherlands would be regularly inundated. So, the extensive system of flood defenses is essential to the safety and habitability of the country and an absolute precondition for healthy economic development.

There are two main categories of flood defenses in the country: primary and secondary flood defenses. All flood defenses structures along the major rivers of the Netherlands and the area around Lake IJsselmeer (including Lake Markermeer) and the delta are part of the primary flood defense system. The total length of these primary flood defenses is over 4,000 km, consisting of dikes, dams and dunes; they include over 800 structures such as pumping stations, navigation locks and quay walls. These defenses are managed 90% by the water boards and 10% by Rijkswaterstaat (Bake and Wolters).

All other flood defense structures are generally identified as regional or secondary flood defense structures (Rijkswaterstaat 2006). There are 14 000 km of secondary flood defense structures, including regional river dikes (for the smaller rivers), storage basin dikes, dikes/flood defense structures used to separate areas with different functions (compartment dikes), polder dikes and dikes/flood defense structures dividing differences in ordnance datum, all of which are managed by the Water boards (Rijkswaterstaat 2006).

These flood defenses have been constructed according to specific standards. For instance, the safety standard for the primary flood defenses ranges between 1/250 per year (upriver) and 1/10,000 (coast) per year (Rijkswaterstaat 2006). This safety standard is defined as the probability of exceedence of the hydraulic conditions.

In order to achieve the same level of protection against flooding, the flood defenses need to be maintained in the future. The Water Embankment Act requires the water boards and Rijkswaterstaat to report on the safety assessment of primary flood defense every 5 years. The safety standard that includes guidelines (VTV) and hydraulic boundary conditions (HR) for safety assessment is established by the Directorate General Water within the Ministry of Transport, Public Works and Water Management. The water boards and Rijkswaterstaat conduct the safety assessment. During the assessment, they check whether the strength of the flood defenses meets the statutory safety standards (Bake and Wolters). The assessment of a flood defense can lead to three categories: the flood defense “meets” the standard, the flood defense “does not meet” the standard, or because of insufficient information “no judgment” can be made.

The water boards and Rijkswaterstaat send their assessment reports to the provincial authorities that make an assessment, which is then attached to the reports and submitted to the Minister of Transport, Public Works and Water Management. Based on its independent position, the Transport and Water Management Inspectorate evaluates whether the assessment or management has been conducted in accordance with the regulations (this is known as official judgment). The results are summarized to create a national picture and analysis is provided together with its findings and conclusions. The Transport and Water Management Inspectorate submits this report to the Minister of Transport, Public Works and Water Management. Based on the summary, the minister informs Parliament about the state of all the primary flood defenses in the country and draws up a program of improvement, known as the Flood Protection Programme, based on the results. (Inspectorate September 2006). 158

During the safety assessment period, preventive maintenance can be performed when the condition of flood defense seems to be threatening. Such maintenance can be called “variable maintenance,” as it is performed after the safety assessment when the condition of flood defense is identified to be threatening. However, there might be a fixed maintenance, performed in particular time interval to ensure good condition of flood defenses. For the maintenance to be implemented, a maintenance plan has to be developed. Such a plan includes things like an area that will be maintained, the equipment that will be used, personnel, maintenance period and maintenance cost. The maintenance plan needs to be approved before the maintenance is implemented.

As already mentioned, an improvement program is drawn based on the safety assessment results. In order to conduct an improvement program, an improvement plan has to be established. This plan can be



established by the flood defense manager, the water board or Rijkswaterstaat. The improvement plan contains the necessary project provisions as well as mitigating and compensating measures for damage done. Moreover, the plan clarifies which measures will be taken to promote the values of landscape, nature, and cultural heritage, the so-called LNC-values (Olsthoorn and Tol February 2001). The established plan has to be approved by the province involved (Olsthoorn and Tol February 2001) before the improvement is implemented. The flood defense improvement implementation has to be inspected to check whether the improvement is done according to the established and approved plan. The flood defense inspection role is the responsibility of the Transport and Water Management Inspectorate.

### CBM components for prevention link

<b>Name:</b> Flood defenses safety		
<b>Purpose:</b> Safety assessment of the primary flood defenses that is conducted every 5 years		
<b>Activity</b>	<b>Activity</b>	<b>Activity</b>
A1:Check flood defense safety assessment	A1:Check flood defense safety assessment	A1:Check flood defense safety assessment
A2: Establish flood defense standard	A2: Establish flood defense standard	A2: Establish flood defense standard
A3: Conduct flood defense safety assessment	A3: Conduct flood defense safety assessment	A3: Conduct flood defense safety assessment
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component Prevention-link 1**

<b>Name:</b> Flood defenses maintenance		
<b>Purpose:</b> Maintenance of the flood defenses		
<b>Activity</b>	<b>Activity</b>	<b>Activity</b>
A1:Flood defense maintenance control	A1:Flood defense maintenance control	A1:Flood defense maintenance control
A2:Develop flood defense maintenance plan	A2:Develop flood defense maintenance plan	A2:Develop flood defense maintenance plan
A3:Approve flood defense maintenance plan	A3:Approve flood defense maintenance plan	A3:Approve flood defense maintenance plan
A4:Execute flood defense maintenance	A4:Execute flood defense maintenance	A4:Execute flood defense maintenance
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component Prevention-link 2**

<b>Name:</b> Flood defenses improvement		
<b>Purpose:</b> Improvement of the flood defenses		
<b>Activity</b>	<b>Activity</b>	<b>Activity</b>
A1:Flood defense improvement check	A1:Flood defense improvement check	A1:Flood defense improvement check
A2:Develop flood defense improvement plan	A2:Develop flood defense improvement plan	A2:Develop flood defense improvement plan
A3:Approve flood defense improvement plan	A3:Approve flood defense improvement plan	A3:Approve flood defense improvement plan
A4:Execute flood defense improvement plan	A4:Execute flood defense improvement plan	A4:Execute flood defense improvement plan
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component Prevention-link 3**

### ***Preparation***

Flooding in the Netherlands is fortunately rather uncommon. This means that the practical knowledge of how to deal with threats of extreme floods and actual flooding is limited. To raise preparedness among all parties involved in flood response and recovery, flood disaster plans or high-water plans are prepared. In addition to the flood disaster plans, training is organized within individual groups with a role in the decision-making chain to practice skills related to their individual task.

The government authorities (i.e. municipality, region and province) are responsible for the preparation and updating of flood disaster plan or high-water plan. Such plans need to be checked periodically for reviews.

A good example of a region in the Netherlands with such a plan is the region of Nijmegen (Bezuyen, MPA et al. Winter 1998). Because of the possibility of floods and the threat of a dike breach, a disaster plan was developed for the region of Nijmegen in the early 1980s. After the flood of 1993 from the river Meuse and the fact that there appeared to be real threat of weakening and breaching of the dikes along the river Waal, the board of mayors from the region decided to update the plan. At the end of 1994, this model was accepted and sent to other regions in the province. Although the other regions had not formally accepted this plan before the 1995 flood occurred, most of the regions could use it as a guideline for their response to the flood. Among the issues dealt in this plan include the following: inundation scenarios, evacuation planning for persons, evacuation planning for animals, communication plan and information for the population. Because the region was well-prepared, it was possible to evacuate about 60,000 people in the region of Nijmegen. The successful evacuation of Nijmegen gave confidence to the other regions that an evacuation of a large number of people was possible.

Apart from the regional flood disaster plans, the National High Water and Flooding Emergency Response Plan has been developed recently (BZK January 2007). Such a plan was 159 deemed to be necessary in the event of high water. The (impending) disaster will strike multiple regions simultaneously, and regions that are not hit will also be involved in coming to the aid of the affected regions and in the care of people evacuated from the regions. Here, the preparations confined to municipal or regional level are insufficient.

As already mentioned, training is also used to raise preparedness among parties involved in flood response and recovery. By implementing multidisciplinary training courses and large-scale exercises, the government is ensuring that relief workers can acquire the right kind of knowledge and skills for potential disasters, so that when needed, they can carry out their tasks efficiently and effectively. Training is also used to test the established flood disaster plans or the high-water plan. Tests will always be needed to establish whether the established plans work, which is why exercises are the final step in effective preparations.

For example, in November 2008, large-scale training was conducted in the Netherlands that involved many stakeholders in the water domain and safety domain. The Flooding Taskforce Management (TMO) was in charge of organizing the large-scale flooding exercise in November 2008. Large-scale training sessions are infrequently conducted, as compared to small-scale training sessions. Due to the importance of training for disasters in the Netherlands, several training institutions recently combined forces and founded a consortium to provide training courses to anyone involved in disaster control or crisis management. This consortium includes Bestuursacademie Nederland (BAN), Crisis Onderzoek Team (COT) of the University of Leiden, Nederlands Bureau Brandweerexamens (NBBE), Nederlands Instituut voor Brandweer en Rampenbestrijding (Nibra), Politie Instituut Openbare orde en Veiligheid (PIOV), and Stichting Opleiding en Scholing Ambulance Hulpverlening (SOSA)(Interior Affairs).

After the training has been conducted, an evaluation regarding measures and the whole flooding process has to be performed. The evaluation is important since during training or a real flood crisis, a new scenario may unfold that was not in the flood disaster plan. As a result, it may take a long time to figure out who could resolve issues presented during such a scenario and how those issues could be resolved. If

necessary, and when it is foreseen that such a scenario can happen again in the future, the manager of the flood disaster plan may decide to update the existing flood disaster plan to include the new scenario.

**CBM components for preparation link:**

<b>Name:</b> Flood response plan		
<b>Purpose:</b> Checking of a flood response plan to ensure that it is up -to date.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Develop flood response plan	flood scenario	Local gov, Regional gov, National gov(BZK)
A2:Check flood response plan		Local gov, Regional gov, National gov(BZK)
A3:Approve flood response plan		Local gov, Regional gov, National gov(BZK)
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component Preparation-link 1**

<b>Name:</b> Training		
<b>Purpose:</b> Training of individuals and organizations within the Flood Control Domain		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1:Manage flood crisis training		Local gov, Regional gov, National gov(BZK)
A2: Plan flood crisis training		Local gov, Regional gov, National gov(BZK)
A3: Implement flood crisis training		Local gov, Regional gov, DHS
A4: Evaluate flood crisis training		Training participants
<b>Offered services</b>		<b>Required services</b>
-		-

**Business Component Preparation-link 2**

## ***Response***

The response phase deals with operations that are directed at managing, containing and combating the consequences of an imminent flood (also referred to as high water) even before the actual flood has occurred. High water occurs when the water rises above a specific pre-defined level; the water defenses have not yet been breached. Although in this situation the disaster has not (yet) taken place, it is considered a crisis situation and large-scale action is taken: full crisis control measures are mobilized (pre-crisis response). This situation thus differs from that of many other types of emergencies (post-crisis response). High water can, but not necessarily, be followed by flooding. In this phase, we will consider actions that are taken not only during the actual flood, but also during an imminent flood.

Therefore, we can say that the response phase starts when a flooding event is predicted through flood forecasting activity. The Inland Information Centre within RIZA, Rijkswaterstaat Regional Departments and the water boards are responsible for daily water level measurement and water level forecasting at the national, regional and local levels, respectively. Under normal conditions, water level forecasting is done every morning, mainly for the benefit of navigation. In times of flood, forecasts are made at least twice a day, again 160

for navigation but also for river management authorities, crisis organizations and population (Sprokkereef 2001).

Among the data needed for flood forecasting is the data about water level measurements and weather forecasts. The water level measurements are collected every 10 minutes by the Geo-Information Department. The Royal Netherlands Meteorological Institute (KNMI) provides weather forecasts on an hourly basis to government agencies, commercial weather bureaus, broadcasters and media (SGI).

Flood forecasting organizations mentioned above use a high-water scaling up procedure as a guideline to initiate crisis actions. This procedure shows what actions can be taken when a certain water level is reached and/or expected to increase. A scaling diagram with regard to river flooding is provided, and the flooding scenario is provided in appendix B.

After a flooding event is predicted, the forecasting authorities warn water management authorities and/or crisis organizations according to the high-water scaling level. Operational high-water management is among the activities that are initiated early when a flooding event is predicted. The water boards and Rijkswaterstaat are responsible for the operational high-water management. They can propose several operational high-water management measures such as pumping out of water, deciding to flood a certain retention area, etc. The effects of the proposed measures are analyzed in advanced before they are selected as the right measures that will be implemented.

Another activity that is also initiated during the early stages of a flooding event is the periodic monitoring or inspection of flood defense such as dikes. The information about the condition of dikes is important for initiating actions like evacuation. It is the role of the water boards to provide the information about the condition of the dykes to other crisis organizations. To do that, the dyke guards are called to inspect the conditions of the dykes. Based on the inspection, or because of known condition of the dyke, the water boards can initiate temporary dyke reinforcement measures such as sandbagging. Because a lot of manpower is needed to perform sandbagging activity, the water boards request additional help from the local people and the army.

During a flood crisis, operational effort needs to be coordinated. At the national level, LOCC is responsible the efficient, coordination of manpower, resources and expertise (the fire service, police, emergency medical aid (offered by the GHOR) and Ministry of Defense) if there is a threat or acute serious crises. Regionally, the coordination of operation efforts is the responsibility of the Regional Operation Team (ROT). Therefore, in case a flood crisis is coordinated nationally, it is the responsibility of LOCC to ensure the availability of operational resources. To achieve that purpose, LOCC periodically analyzes operational resources by checking what resources are available, where these resources are and how many resources are needed. In case of insufficient operational resources, LOCC drafts an advice

report requesting additional resources. The decision for additional resources is taken at the Inter Ministerial Policy team meeting (BZK January 2007).

Once a flooding is predicted, people need to know about the possible flooded areas and the time of the flooding. This information is provided locally by the water boards. At the national level, the National Flood Threat Coordinating Commission (LCO) becomes responsible. LCO is activated and managed by the Departmental Coordination Centre within the Ministry of Transport, Public Works and Water Management. The water boards and LCO perform an analysis for the possible flooding areas and flood break time. In order to perform the 161 analysis, a combination of information is required including the water level measurements, weather forecast, flood forecast and the condition of the threatened water defenses. Based on their analysis, the LCO advises the Inter Ministerial Policy Team and the Ministerial Policy Team of the chance that the threatened area will actually be flooded, the size of the (potential) flood area and the time left before the flood breaks (BZK January 2007).

In addition to the prediction of possible flooded areas and flooding time, the effects of flooding in terms of casualties and economic damage in the predicted areas need to be analyzed in advance. This information is important to initiate actions that aim to reduce flooding effects such as evacuation. The municipalities perform both the causality analysis and economic damage analysis.

Due to the possibility of flooding, evacuation preparations are initiated. On one hand, some authorities are responsible for the preparations of evacuation implementation. In doing so, they develop an evacuation plan and prepare resources needed for the evacuation purpose. Among the things included in the evacuation plan are the required evacuation time, the exit points and evacuation routes that people can take to evacuate from the flooded area. An evacuation plan and evacuation process discussed here is a general one. However, specific evacuation plans must be integrated together. For instance, these plans may be specific for population in a threatened area without a need of assistance, the population in a threatened area with the need of assistance (e.g. the nursing homes, the patients in hospitals), prisoners and animals.

On the other hand, some authorities are responsible for checking whether an evacuation has to be done. In doing so, an evacuation decision-making process is initiated. At the national level, if a disaster affects more than one province or country, the Minister of Interior Affairs decides on evacuation. If a disaster affects a single province, the Queen's Commissioner can decide to evacuate the population. Regionally, if flooding affects more than one municipality, the appointed coordinating Mayor within a region can decide on evacuation. Locally, when a single municipality is affected, moreover, and this is very rare for a flooding disaster type in the Netherlands, the Mayor of the municipality could decide on the evacuation.

Let's consider a flooding crisis coordinated at the national level. Therefore, the evacuation decision is made by the Ministry of Interior Affairs. He does this after consulting with the regional authorities and Queen's Commissioners and discussing the decision in the Ministerial Policy Team meeting. Among important information needed for evacuation decision making is the available time (i.e. the time from the moment of the warning to the anticipated moment of flooding) and the required time (i.e. the time required to evacuate all inhabitants from the disaster area). Depending on the way in which these timeframes interrelate, the Minister of Interior Affairs will decide whether or not to evacuate wholly or partially on the ground of the Population Evacuation Act (BZK January 2007). Once an evacuation has been decided, some relief activities will focus on implementing the evacuation, some relief activities will focus on measures to manage or cordon off the area (prevent further disaster after the flood), while other relief activities in the non-threatened regions/provinces will focus on setting up shelters, implementing shelter care measures and registering evacuated victims. LOCC coordinates all these activities. In doing so, LOCC mobilizes the necessary operational resources required for carrying out these activities. 162 Moreover, traffic control measures need to be implemented in case a large-scale evacuation is implemented. Without implementing traffic control measures, it may be impossible to evacuate a large population within a certain time limit.

### CBM components for response link

<b>Name:</b> Weather forecasting		
<b>Purpose:</b> Provide weather forecast.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Weather forecast check		KNMI
A2: Weather forecasting	Weather data	KNMI
<b>Offered services</b>		<b>Required services</b>
-		-

Business component Response-link 1

<b>Name:</b> Flood forecasting		
<b>Purpose:</b> Forecast flood possibility based on the high water indication.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Flood forecast check		RWS(WD)
A2: Flood forecasting	Water level measurements	RWS(WD)
<b>Offered services</b>		<b>Required services</b>
-		-

Business component Response-link 2

<b>Name:</b> High water management		
<b>Purpose:</b> Provide response measure based on high water indication report.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Control high water		VenW(RWS), Water boards
A2: Evaluate high water management measure	River observation	VenW(RWS), Water boards
A3: Propose high water management measure	Water level measurements	VenW(RWS), Water boards
A4: Select high water management measure	Water level measurements	VenW(RWS), Water boards
A5: Implement high water management measure		VenW(RWS), Water boards
<b>Offered services</b>		<b>Required services</b>
-		-

Business component Response-link 3

<b>Name:</b> Flood defense operational management		
<b>Purpose:</b> Manage and monitor the flood defenses to ensure proper operation continuity disregarding the flood threat.		
Activity	Resources	Organization
A1: Manage flood defense operation		Water boards
A2: Flood defense inspection	Damage type, Damage location, Damage time	Water boards
A3: Take flood defense temporary reinforcement measure	Water level measurements	Water boards
A4: Mobilize temporary flood defense reinforcement resource	Water level measurements	Water boards ROT, LOC
A5: Implement temporary flood defense reinforcement		
Offered services		Required services
-		-

Business component Response-link 4

<b>Name:</b> Operational resource management		
<b>Purpose:</b> Check the operational resources (personnel and equipment) that are used for flood fighting activity		
Activity	Resources	Organization
A1: Check operation resource		ROT, LOCC
A2: Analyze operational resource	Resource list	ROT, LOCC
A3: Draft operational resource bottleneck advice		ROT, LOCC
A4: Take operational resource bottleneck measure		ROT, LOCC
Offered services		Required services
-		-

Business component Response-link 5

<b>Name:</b> Inundation management		
<b>Purpose:</b> Check the possible flooded areas and possible flood break time		
Activity	Resources	Organization
A1: Inundation probability check		Water boards, LCO
A2: Perform inundation analysis	TODO	Water boards, LCO
A3: Provide expert advise	TODO	Water boards, LCO
Offered services		Required services
-		-

Business component Response-link 6



<b>Name:</b> Causality management		
<b>Purpose:</b> Casualty flood damage evaluation		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Causality evaluation		Local gov
A2: Perform causality analysis	Population data, Evacuation victim registration data	Local gov
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Response-link 7**

<b>Name:</b> Economic flood damage management		
<b>Purpose:</b> Analyze the possible economic damage of the flood		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Economic damage evaluation		Local gov
A2: Perform economic damage analysis	Land use plan	Local gov
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Response-link 8**

<b>Name:</b> Evacuation management		
<b>Purpose:</b> Preparation for evacuation implementation		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Prepare evacuation implementation		Threatened Regional/ Provincial gov
A2: Develop evacuation plan		Threatened Regional/ Provincial gov
A3: Prepare evacuation resource	Resource list	
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Response-link 9**

<b>Name:</b> Evacuation implementation		
<b>Purpose:</b> Implement the evacuation plan.		
Activity	Resources	Organization
A1: Check evacuation		Threatened Regional/ Provincial government
A2: Decide evacuation	inundation analysis data, Expert advise	Minister BZK
A3: Complete evacuation		
A4: Mobilize evacuation resource	evacuation resource data, evacuation plan data	Threatened ROT, LOCC
A5: Implement evacuation	evacuation resource data, evacuation plan data	Police
A6: Take shelter care measure		Netherlands Unthreatened ROT, LOCC
A7: Shelter set up	Shelter location, Shelter size, Shelter facilities	Local gov
A8: Mobilize shelter-care resource	Resource list	Netherlands Unthreatened ROT, NRK,LOCC
A9:Implement shelter -care measure		Netherlands Unthreatened ROT, LOCC
A10: Evacuation registration	Personal data	NRK, CRIB Team
A11: Cordon off evacuated area		Police
A12: Cordon off arrangement	Disaster zone location	Police
A13: Mobilize cordon off resource	Resource list	Police
A14: Install cordon off equipment		Local gov
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Response-link 10**

### **Recovery**

As already mentioned, the recovery activities ensure that the affected population can return to its normal routines. Recovery operations should commence as early as possible during flood response operations. Therefore, it is important to note that the links in the safety chain approach are not sequential. They can be regarded as aspects of management, not phases.

While in evacuated shelters, people register for damage settlement and the damage claims are organized. This registration is done by the Central Damage Registration and Reporting Point (CRAS) team. The state government is responsible for the claim payments (BZK January 2007).

Another concern during this period is the restoration of flood defenses to normal operations. In doing so, the repair of failed flood defenses is initiated. Each repair has to be planned. Among the things that are included in the repair plan are resources that will be used and the cost of repair. The developed repair plan has to be approved before the repair work is implemented.

Moreover, other authorities research when people can return. The water board councils and LCO perform the return analysis. Based on their analysis, LCO provides advice to the Ministerial Policy, which then decides on scaling down crisis activities in consultation with the highest administrative parties. Based on the LCO's advice, the Ministry of Interior Affairs can decide whether to return evacuated victims to their original homes; LOCC coordinates the return. In doing so, LOCC mobilizes operational resources needed for implementing the return activity.

Finally, the whole flood crisis has to be evaluated, regarding measures taken. An evaluation document will provide an insight and can be used to provide lessons to all the organizations that were involved during the crisis. Such lessons can be used to update existing flood scenarios as well as the flood disaster plan or high-water plan.

### **CBM components for recovery link**

<b>Name:</b> Recovery management		
<b>Purpose:</b> Analyzing of flood crisis evaluation.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Recover failed flood defense operation	Flood defense inspection data	Water board
A2: Develop flood defense repair plan	Flood defense inspection data	Water board
A3: Approve flood defense repair plan	Flood defense inspection data	Water board
A4: Implement flood defense repair	Flood defense inspection data	Water board
<b>Offered services</b>	<b>Required services</b>	
-	-	

**Business component Recovery-link 1**

<b>Name:</b> Damage claims organization		
<b>Purpose:</b> Organizing of damage claims		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Damage claim organizing		CRAS Team
A2: Damage claim registration	Personal data, Eligibility proof data	CRAS Team
A3: Damage claim payment		National gov
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Recovery-link 2**

<b>Name:</b> Return management		
<b>Purpose:</b> Check the return of the evacuated population		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Check return possibility		Water board, LCO, Local gov
A2: Conduct return analysis	Area survey data, Flood defense inspection data, Flood forecasting data, Weather forecasting data	Water board, LCO, Local gov
A3: Advise return		Water board, LCO, Local gov
A4: Decide return		Netherlands Minister of BZK
A5: Complete return		ROT
A6: Mobilize return resource	Resource list	ROT
A7: Implement return	Resource list	Police
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Recovery-link 3**

<b>Name:</b> Flood crisis evaluation		
<b>Purpose:</b> Checking of flood crisis evaluation.		
<b>Activity</b>	<b>Resources</b>	<b>Organization</b>
A1: Check flood crisis evaluation		Inter Ministerial Policy Team
A2: Evaluate flood crisis measure	Situation reports	Inter Ministerial Policy Team
<b>Offered services</b>		<b>Required services</b>
-		-

**Business component Recovery-link 4**

## Appendix B

### National Water Plan – A Summary

**The National Water Plan: The Netherlands, a safe and liveable delta, now and in the future.**

In the last decade, the Fourth National Policy Document on Water Management (*Vierde Nota Waterhuishouding*), the Water Management in the 21st Century Advisory Committee (*Commissie Waterbeheer 21e eeuw*) and the National Administrative Agreement on Water (*Nationaal Bestuursakkoord Water*) represented an important impulse for water management. With this first National Water Plan, which is also a framework vision based on the new Water Act (*Waterwet*) and the Spatial Planning Act (*Wet Ruimtelijk Ordening*) and drafted for the 2009-2015 planning period, we are entering a new phase. Because we want future generations to be able to enjoy the Netherlands as a safe and affluent land of water, we have to find answers now to developments in climate, demography and economy, and invest in sustainable water management. Effective flood defences are basic preconditions for prosperity and well-being, prevention of floods and drought wherever possible, and good water quality are achievements that the Netherlands has, in large measure, water to thank for, in addition to its favourable location and an excellent freshwater supply. The Netherlands, an attractive country with an abundance of water and high levels of safety, contributes positively towards the quality of the living environment and the conservation of biodiversity. Water is wonderful and the Dutch love it. The aim is crystal clear: the Netherlands, a safe and liveable delta, now and in the future.

#### **Sustainable and climate-resistant water management**

In the 2007 Outlook on Water (*Watervisie*), the Cabinet set out the aim of stepping up its ambitions and pursuing sustainable and climate-resistant water management. To achieve this aim, the Cabinet established a second Delta Committee (*Deltacommissie*) to advise on water policy for the next century and beyond. In 2008, the Delta Committee proposed increasing flood protection and securing freshwater supplies in the long term, an advice it embedded in twelve recommendations. The Cabinet endorsed this cohesive vision and decided to use it as a starting point for further elaboration. The first policy-based detailing of the vision now forms part of this National Water Plan. To guarantee the continuity and cohesion of this approach in the long term as well, the Cabinet will be introducing a Delta Bill (*Deltawet*) in 2009, addressing the legal basis for the Delta programme (*Deltaprogramma*), the tasks and powers of the Delta manager, and the way in which a solid financial base can be laid. The central government's ambition is to invest in flood protection and defence and in freshwater supply in the next decades. Expenditure is not included in the draft National Water Plan but will be detailed in 2009 in the context of the Delta Act and the Delta Programme.

#### **Measures in full swing**

Alongside all these plans for ensuring the future safety and liveability of the Netherlands, the implementation of measures are already in full swing. The Flood Protection Programme (*Hoogwaterbeschermingsprogramma*) and programmes for river widening, Space for the River (*Ruimte voor de Rivier*), and the Meuse projects (*Maaswerken*) are making good progress. The National Administrative Agreement on Water, updated in 2008, is being used to order the water systems by 2015, especially in terms of flooding and water shortages. In the planning period, river basin management plans are being carried out to ensure improvements to the necessary water quality of the Ems, Meuse, Rhine and Schelde Rivers.

The funds the central government is freeing up for the planning period suffice to carry out the planned measures for which the central government bears responsibility.

#### **Working together to implement water policy**

Co-operation between government bodies is being intensified. Examples include the result-driven work on the Water Framework Directive (*Kaderrichtlijn Water*) and Space for the River. It is being considered

whether collaboration between the river basin authorities can be made more effective. The Delta manager will be given a key task when it comes to water safety and freshwater supply. An area-based approach is to become the standard for implementing measures, which means not only deciding what is needed from the perspective of the water system but more especially, working with all stakeholders in applying a development-gear approach and seizing opportunities. Innovating and generating new knowledge are key to making the most of these opportunities and bringing about renewal. The central government wants everyone to co-operate proactively. For many, water is still a given. What we need is to raise awareness of the opportunities afforded, as well as the risks entailed.

### **Going with the flow, offering resistance, seizing opportunities**

The basic principle of sustainable water management is to 'go with the flow of natural processes where possible, offer resistance where necessary and seize opportunities to foster prosperity and well-being'. Making room for water, going with the flow where possible and utilizing natural processes such as is now the case with Space for the River are essential for sustainable water management. The central government considers it vital that water tasks and measures are optimally embedded into other types of tasks and measures.

Offering resistance fits in well with the Dutch tradition of building dykes and dams to defend the land against water and managing water levels in polders, tasks that are essential if we are continue to live and work in the Netherlands. Grasping the opportunities water offers is an attitude the Cabinet values highly. Water plays a significant part in enhancing the spatial quality of rural and urban areas – water is what makes the Netherlands beautiful. All manner of activities can be combined with water management, such as leisure activities, nature and landscape, agriculture, renewable energy production and housing. Taking an area-based approach is often a way of improving water management whilst reinforcing the economy and the living environment at the same time. And this should be done at a social cost that is as low as possible.

### **Enhancing water and space**

Taking short-term and long-term water management requirements into consideration during spatial development is essential for a sustainable and climate-resistant water system. Conversely, water managers need to be aware that there is far more to be achieved in all areas than just water-related targets. They must also anticipate spatial and economic developments.

Water is to play a more influential role than hitherto in decisions regarding major tasks in the areas of urbanization, commerce, industry and agriculture, nature, landscape and leisure activities if a sustainable and climate-resistant water system is to be accomplished. The extent to which water is a defining factor in spatial developments depends on the nature, scope and urgency of the water task in relation to other tasks, existing functions and soil quality, as well as other area-specific features. The key is as always to strike a balance between different interests.

The Land Use Planning Memorandum (*Nota Ruimte*) regulates the spatial consequences of the current water policy. This is set to change. A General Administrative Order on Space (*AMvBRuimte*) will be introduced in 2009 for areas that are part of the National Spatial Structure, i.e. the coast, the large rivers and the IJsselmeer lake area. The National Water Plan, which is also a framework vision based on the Spatial Planning Act, replaces certain policy sections of the Land Use Planning Memorandum pertaining to the IJsselmeer lake, the North Sea and the rivers. The protection of vital functions and vulnerable objects is a subject of national importance, though it is not limited to areas in the National Spatial Structure. The central government will be drawing up a separate General Administrative Order for this on the basis of a flood risk pattern, in order to protect telecommunications, ICT and energy networks as well as evacuation routes in the event of flooding.

The central government is expanding and enhancing the operation of the water test and will evaluate its effect in 2011. It is asking provinces and local councils to involve water managers at as early a stage as possible when drafting framework visions by requesting their advice on and asking them to write a section on water. The central government will then look into effective measures or means for keeping space for water available in the long term, supplementary to the tool of spatial reservation.

### **Working toward a safe delta**

Climate change increases the threat of water. Furthermore, the values to be protected have increased significantly in the last decades. The Cabinet is opting for a sustainable water safety policy by focusing on 'multi-layer safety'. This is a three-tier or 'layer' approach to our protection, the first of which is prevention, i.e. preventing flooding. This is and remains the cornerstone of water safety policy, even though it can never be ruled out completely. The second and third layers are therefore aimed at limiting the effects of flooding. The aim of the second layer is to create a sustainable spatial layout of the Netherlands and the third seeks to improve the organizational preparations for a potential flood (disaster mitigation). New standards are to be established on the basis of flooding risk, which will be tested every six years against water levels and wave heights that are expected twelve years later. The level of the standards will be decided in 2011, based on a cost-benefit analysis and an analysis of the potential number of casualties. The consequences of the safety standards increased by a factor 10 as proposed by the Delta Committee will also be shown.

Research is to be conducted into robust and wide delta dykes. With a view to sustainable spatial development, the provinces, water boards and the central government are jointly charting flooding risks which will be mapped out in zones by 2012.

The central government is encouraging water managers and safety regions to draft co-operation agreements, in addition to their existing statutory obligations, establishing the role they are to fulfil in disaster mitigation during an actual or impending flood. The results of the work done by the Flood Management Taskforce (*Taskforce Management Overstromingen*) and the outcome of the 'Waterproof' (*Waterproof*) operation will be embedded in policy.

This multi-layered approach to safety requires area-based custom work. In association with regional parties, the Cabinet will be expounding this approach in area pilot schemes. The European Directive on Flood Risks (*Europese Richtlijn Overstromingsrisico's*) will be introduced into Dutch legislation during the planning period. Risk maps and flood risk management plans are to be jointly developed with neighbouring countries.

In 2009, the central government will be taking the initiative to inventory and assess potential bottlenecks in the areas outside the dykes. Together with administrative partners, it will consider whether policy amendment is needed. This re-evaluation will take place in the light of the new standards and will create a link with basic safety.

### **Sustainable freshwater supply**

Existing freshwater supply agreements will remain in force until 2015. Policy is, under normal circumstances, geared towards meeting users' needs wherever possible and, as yet, no big problems are expected until 2015, again under normal circumstances. In periods of water shortages (in dry summers), water will be distributed on the basis of the list of priorities and the damage to be contained.

In this planning period, the central government will be making long-term decisions on freshwater supplies and salinisation control, including any infrastructure measures this may require. In the coming planning period, possible solution strategies are to be worked out with the regions. The key aspects of this new strategy are greater levels of regional self-sufficiency and optimization of the freshwater distribution in the main and regional water systems. For this too, the central government, the regions and the users will be hammering out solutions in the coming planning period. Solutions and areas will be considered as a cohesive whole and the (spatial) consequences for regional systems and functions (drinking water, agriculture, nature and shipping) made transparent.

### **Cleaner water and a natural design**

The Cabinet is holding on to a combination of tackling pollution at source and improving the design of the water system, reflected in the river basin management plans for the Ems, Meuse, Rhine and Schelde rivers for the 2009-2015 period. Alongside continuation of the (international) approach to sources and the treatment of wastewater, a new key element is improvement of the design. During this period, for example, some 2,400 km of eco-friendly banks and over 630 fish ladders will be made. The fight against

pollution continues – 290 sewage overflow points are to be tackled and improvements made to more than 50 wastewater treatment plants. Despite all these activities, the aims of the Water Framework Directive have not been achieved yet. The Cabinet has set aside 75 million Euros to promote innovations intended to further improve water quality.

### **Water policy for coast, rivers, IJsselmeerlake, south-west Delta, North Sea and urban areas**

The coast is growing. The Cabinet is opting for sand replenishment as a way of enabling the coastal foundation zone to grow concurrently with the rise in sea levels. Where possible, this is to take place by distributing and transferring sand naturally along the coast. In addition, the Cabinet is opting for a cohesive approach to area development that allows for a balanced development of nature, economy and accessibility in the existing coastal areas. The Delta Committee has suggested extending the coast line to provide more space for functions in the coastal area. In the planning period, the central government will be exploring the feasibility of this proposal.

The rivers are expanding. The key planning decision (*PKB*) Space for the River and the Meuse Projects are progressing steadily, which means that by 2015, the Rhine will be able to handle a peak discharge level of 16,000 m<sup>3</sup>/s and the Meuse a discharge level of 3,800 m<sup>3</sup>/s. Steady progress is also being made implementing the Rhine and Meuse Action Plans on Flood Defence (*Actieprogramma's Hoogwater Rijn en Hoogwater Maas*). Future agreements will be made in the perspective of the flood risk directive.

Where possible and cost-effective, measures can already be taken for discharging 18,000 m<sup>3</sup>/s from the branches of the Rhine and 4,600 m<sup>3</sup>/s from the Meuse, for example, by establishing a link between the water task and spatial developments. To anticipate the safety task after 2015, lands should be set aside and where necessary, purchased, outside and possibly also inside of the dykes.

The central government is working with all authorities involved on the formulation of a long-range task for areas outside of the dykes along the rivers, taking account of safety, nature, water and spatial quality and (regional) spatial developments in favour of a balanced application, management and use of the riverbed.

As for the Rijnmond and the Drechtsteden regions, the Cabinet recognizes the significance of guaranteeing the protection against flooding of the rivers and the sea in the long term as well. At the same time, the negative effects of salinisation in this area must be prevented. Following on from the recommendation of the Delta Committee, the central government and other authorities will be conducting research into a 'closable-open' Rijnmond.

The level of IJsselmeerlake is to be raised. The Cabinet is opting to reinforce the strategic function of the IJsselmeer lake area to supply freshwater. By making small adjustments to the water level management regime, space that the system currently has anyway can be used in the short term. In the long term, use will be made of the additional water that is created by raising the water level of the lake. Research is being done to see what is needed to supply freshwater to the west of the Netherlands as well. In connection with this, the Cabinet has elected to retain the current system of natural water drainage through inlet sluices to the Wadden Sea for as long as possible.

The Cabinet has decided to unlink the MarkermeerLake and the Veluwerandmeren lakes from the IJsselmeerlake. The result is a water level management in the Markermeer-IJmeerlake and the Veluwerandmeren lakes that corresponds far better with what is needed for ecologically sustainable development. It also opens up possibilities for limited building activities in the Markermeer-IJmeerlake outside of the dyke. A pumping station will be built for the Houtribdijk.

The Cabinet is opting to allow a restricted number of developments outside the dykes that take the spatial quality of the area into account. The loss of water storage capacity as a result of developments outside of the dykes does not have to be compensated.

The Cabinet has decided to reinforce the IJsselmeer dam (Afsluitdijk), while endeavouring to combine this with a multifunctional arrangement that meshes with the existing core qualities of the IJsselmeer lake area and makes allowance for the lake's strategic freshwater supply in the long term.

The south-west Delta is to be given a dynamic quality. Working on flood defenses remains crucial in the south-west Delta. The coastal foundation zone will grow naturally with rising sea levels. The northern Delta reservoir and the Volkerak-Zoommeerlake will have to provide sufficient drainage and storage



capacity to cope with the increase in discharge from the major rivers. Reinstating tidal dynamics increases the self-cleansing and natural production capacity of the water and ensures a better distribution of the nutrient load in the various bodies of water. Fish can swim from the sea to the rivers and vice versa. Possible solutions for addressing sand demand in the Oosterschelde estuary are being explored, using a variety of resources, including sand replenishment. Reinstating tidal dynamics does mean, however, that the targets of the Water Framework Directive in the river basin management plans for some of the waters will have to be adjusted in six years' time. This applies to the Volkerak-Zoommeerlake, for example, into which salt will again be allowed before 2015.

The North Sea will become more sustainable. The Cabinet is opting to use the North Sea in a way that is sustainable and safe and makes efficient use of space, while keeping it in balance with the marine ecosystem as set out in the Water Framework Directive, the Marine Strategy Framework Directive, the OSPAR convention and the Bird and Habitat Directive. In consultation with the Dutch fishing sector, nature protection organizations and other EU member states, and within the framework of the European Common Fisheries Policy, the focus is on working towards the sustainability of fishing in the North Sea. Views across the sea to the horizon are to remain open.

Within international frameworks, the Cabinet is giving priority to the following activities that are of national importance for the Netherlands:

Sand extraction and replenishment: sufficient space for protecting the coast, counteracting flood risk and for fill sand on land;

Sustainable (wind) energy: space for 6,000 Megawatt of wind energy on the North Sea in 2020 (at least 1,000 km<sup>2</sup>, creating conditions for further (international) growth after 2020;

Oil and gas field development: extracting as much natural gas and oil from the Dutch fields in the North Sea as possible; Sea shipping: building a system of traffic separation schemes, clearways and anchoring areas allowing safe and prompt handling of shipping; Defence areas at sea.

Existing and new users will be informed of the space available for new activities and the conditions attached.

Urban areas to become more livable. Tasks such as those that involve living, working, mobility, leisure activities, landscape and nature, water and the environment are to be addressed cohesively. The aim is to increase green spaces and water in city developments, making urban areas more attractive and liveable. In this context, the central government is encouraging living on water, which can contribute towards a climate-resistant blueprint of the Netherlands because it is a form of dwelling that can be combined with space for water.

Advanced urbanization and climate change are being taken into consideration in the approach to the urban water task, and where possible linked to the dynamics of the city. The implementation of measures is being combined with the restructuring of existing built-up areas and the creation of green zones in and around the city. Combining water and green zones offers plenty of opportunities to make urban water systems more robust and climate-resistant. Good connections between urban water systems and the surrounding land contribute towards good quality water and landscape. Water offers potential for improving the living environment in existing urban settlements. Best practices applied elsewhere in the world will be inventoried in the planning period and Dutch cities will be involved.

#### **The Netherlands works with water on a worldwide scale**

The Cabinet wants the Netherlands to co-operate actively with countries in low-lying delta areas, protecting them against floods and ensuring sufficient and clean water. Central to this are climate adaptation and contributing towards achieving the millennium goals. The Cabinet is focusing its attention on a number of deltas and, in 2009, will be choosing between the Jakarta, the Mekong, the Ganges/Brahmaputra, the Incomati and the Nile deltas. In doing this, the Netherlands will be entering into long-term co-operation agreements. These partnerships will be based on the existing Partners for Water (*Partners voor Water*) programme, which is to be extended for a period of six years to 2015. In addition, where opportunities arise and a demand for Dutch technology and knowledge is made known, the Cabinet is opting for an approach based on a global positioning of the water and delta technology sectors of



industry. An international 'Water Sector Marketing Programme' (*Marketing Programma Watersector*) is to be developed in 2012.

**Taking the plunge!**

With this National Water Plan, the Cabinet has opted for a future-driven national water policy based on concrete measures that can be taken now. A plan the Cabinet wants to realize with you: working towards a safe and livable Netherlands, now and in the future.

