Coupling of DEMO and ARIS

Based on theoretical ground

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Master Thesis report

Thesis project

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Preamble

This paper is written as the last assignment of the information architecture master phase at the Technical University of Delft. Computer Science is taught at the technical University of Delft and Information Architecture is a variant of this program. Information Architecture draws attention to the internal as well as to the external information streams in organizations. Which information is needed to act appropriately in given situations; making of blueprints before constructing the idea (think it through before acting). As a member of the Information Architecture group, one has to perform a thesis project at the university, either internally or externally, to gain a master’s degree at the TUDelft. The thesis project is carried out at the Corporate Dienst\(^1\) of RWS, in Utrecht and the subject of the report is about the essential structuring of organizations. As a result, two methodologies are researched and the main focus of this thesis research is to create integration between these two. The ARIS [7] methodology, which is being used at the central division (CD) of RWS, is a description about the whereabouts of the organization and its systems. The descriptive method of the Corporate Dienst of RWS is the EPC-tool of the ARIS methodology. The DEMO methodology is developed at the Technical University in Delft, and the idea is to integrate the EPC-tool with the DEMO methodology on a theoretical ground in this thesis report.

Large organizations are getting more and more complicated nowadays. These complications keep on aggravating and increasing in future. Managers considered on using methodologies or tools to structure the organization as an attempt to maintain its lead and manage its complexity. There are many methodologies available on the market, but only some are accurate enough to benefit from. A research about the ARIS and the DEMO methodology is performed and hereby stating the deficiencies and the advantages of both. The main aim of this study is to provide cooperation between these two methodologies in a way to qualify the organization and gain benefits from its utilization.

\(^1\) www.rws.nl
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The Corporate Dienst provided an excellent context to test the captured proposition of the theory in the particular area of study. Many persons provided me help towards performing this case study at the RWS. I would like to thank my supervisors, Prof. Dietz and Drs. Lemmen, for being understanding persons, for the fine conversations being and for giving me proper feedback on the papers I wrote. Also I would like to thank many employees of the Corporate Dienst, who were very helpful towards the research.

Prof. Dietz as well as drs. Lemmen provided many comments on previous versions of this paper; these comments have all found their ways into this paper.

I would like to acknowledge the kindness of dr. Op ‘t Land who helped me to gain this thesis assignment at the Corporate Dienst. He helped me with little comments, pointers and encouragements that helped me to understand the features of DEMO more appropriately. I have often looked at his work at the RWS during the thesis project.

Two more supervisors were needed for the fulfilment of the master thesis project. Therefore I thank Dr.ir. J. van den Berg and Prof. drs. dr. L. J. M. Rothkrantz for their support and kindness in becoming members in my master thesis commission.

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Abstract

Cooperation is a form of communication between involved parties (organizations). Previous researches already indicated that organizations are encountering several problems regarding communication. There are more than enough supporting methods and management tools to remedy these problems. These supporting methods can however only cope with a part of the problems. Therefore measures need to be taken to remove the rest of the problems. The solution could be searched in the description methodologies, which are being used in organizations. This report will state the DEMO and the ARIS methodology. In performing the thesis, I made use of literature as well as interviews with several people, who have practiced and expert knowledge about the subject. The SWOT [33] analysis is resulted from this research. Although ARIS provide a large amount of tools, in reality only a short amount of these tools are used. The focus is merely on developing the process after formulating the organization’s specifications of the requirements. In the literature the problems are more focused on the solving of problems and supporting the deficiencies of the method. Contrary to this, the interviews brought attention to important considerations and goals of the organization. The goals determine whether the methodology will be used as a remedy to structure the requirements and help to develop processes, or as a support to guarantee the quality. The basic steps of the methodologies that allow business analysts to produce detailed, formal specifications of business processes from high-level enterprise objectives are also outlined in the paper.

In summary, the original contributions of this paper are the following. A formal approach to enterprise and business process modeling is presented. The basic steps of a methodology, which can be used by an enterprise for analyzing and redesigning an existing business process, or developing a new one, are sketched. The methodology starts with the objectives of the enterprise and produces a detailed formal specification of a business process, which achieves these objectives. The formal specification is developed as a set of sub models that capture the business process from various viewpoints. Corporate Dienst makes use of the EPC tool of ARIS to describe the processes of RWS. ARIS however is not sufficient enough
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to describe the organization in was clear way and with a apparent structure. The management board of CD voiced their need for more understanding and therefore clearer overview.
The methodology being used needs to supported by another methodology, in such a way by fulfilling the deficiencies of ARIS. The DEMO methodology is already being used in great of DID\textsuperscript{2}, anot division of RWS. This methodology claims to provide a solid and stable overview of the entire organization on the highest level. These two methodologies need to be combined and this is the starting point of the research project. Af first both methodologies have to be examined.

CD and DID can cooperate smoothly with each other, after a clear overview and a vast coupling is generated of the methodologies. However this remains to be seen.

\textsuperscript{2} Data and ICT Dienst, this division is responsible for the data provision and the support of systems through the entire organizations.
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1 Introduction

More and more companies nowadays are stating the necessity for well-suited methodologies to describe their organizations. The necessity is resulted from the fact that the current describing methodology of the organization is not providing satisfactory and sufficient outcome. This problem is already being addressed in several companies and there is need for solutions.

The master program focuses on organizations in any form and discusses the reasons of its complexity. An organization for instance is complex if it has many involved parties, many product demands, many applications, etc. Several relations thus highlight it. These are important issues that need to be addressed and handled. There are different ways to provide solutions to simplify the complexity. Describing methodologies should provide vast descriptions of the organization. The company must be able to rely and support on these descriptions whenever needed.

Many methodologies are theoretically well described, but are not providing enough success and satisfaction in organizations in real time. There is need of (a) methodology (ies) that can cover the entire demand of the organization on a qualified level.

The remaining part of this paper is structured as follows.
Chapter 1 contains the aim of the research as well as the problem definition is also given here.
The context of the research is given in chapter 2. A testcase is used to throw light on the EPC tool of ARIS. The chosen testcase is Incident Management (IM), which is outlined in chapter 3.
A short description as well as the applicability of the DEMO methodology is given in chapter 4.
Both the models of IM are compared through the SWOT in chapter 5. The conclusion of the research is given in chapter 6. This last chapter also provides some ideas for further research. The research also sketches the basic steps of the methodologies.
1.1 The aim of the research

This chapter will elaborate on the subject of the thesis project. Research will be performed about DEMO and ARIS (EPC), which are methodologies for describing the organization of enterprises. EPC models are obtained through the ARIS methodology and the EPC construction guidelines. The strengths and the weaknesses as well as the different characteristics of these methodologies are captured through a SWOT [33] analysis. The ultimate aim of this thesis project is to create a junction between the two methodologies. There can be a better communication and with that a better cooperation and collaboration within the organization with the two merged methodologies.

A short example of Rijkswaterstaat will be given to illustrate the theory in practice since the thesis project is being performed at a division of Rijkswaterstaat. A section of the traffic management of the main highways (Verkeersmanagement Hoofdwegennet, VMHWN) will be modelled as an illustration in the thesis project. VMHWN is a large essential process of RWS and is therefore divided in 6 logical divisions:

1. Control (“sturing”) of VMHWN
2. Preparing & management of VMHWN
3. Normal circumstances (NC)
4. Exceptional circumstances (EC)
5. Crisis management
6. Journey & directing information

VMHWN is divided in the first place to provide a clear overview of the entire process and to increase the quality of the process outcome. If for instance a problem occurs on the main road, it should be solved with the suitable department and according to the guidelines of that department. The Control part of VMHWN is in hierarchical senses the management of the other parts. Control is responsible for the realization, quality management and also the maintenance of the VMHWN.

Verkeersmanagent Hoofdwegennet is a primary process of Rijkswaterstaat, which focuses on the management of the main highways in the Netherlands.
The highways are being maintained according to a time limit, but whenever something is broken, it gets repaired directly.
The preparation & management is the actual execution of the plans made in the Control part. Measures are taken according to the circumstances at that moment. These are the normal and the exceptional circumstances.

An example of a normal situation is the occurrence of the traffic lights; the driver has to stop, when the light turns on red.
An example of an exceptional situation is the occurrence of an accident between two cars on a heavy loaded road on the highway. This accident will cause traffic jam on the road, which must be avoided through redirecting of the remaining traffic.
Whenever an exceptional circumstance is out of proportion and cannot be managed according to the normal protocol, ad hoc measures must be taken to solve the risen problem. 
Incident Management (IM) is an important section of the EC. Incident management tries to maintain the previous situation on the road, before the incident occurred. The focus of this thesis will be on the incident management of VMHWN. The main differences between DEMO and ARIS are given in the research paper through the SWOT. A conclusion is also given consequently to this SWOT analysis. The theory of the research paper will be applied to the IM in a way to throw light on the already deduced conclusion.

Figure 1 exceptional context
1.2 Theoretical ground

A few essential subjects are clarified before the elaboration of the theme of the paper.

**Business processes**

A business process can be seen as a collection of related and logical tasks that have a pre-defined, specific result. The IT of an organization must change whenever an organization changes in terms of new products or its service deliverance. Organizations must have the ability to change with its fast changing environments.

**Business process management**

It is important for the accuracy of an organization to adjust its business and IT with each other. Business processes decide how an organization operates and must be well supported by the IT processes (services). Business Process Management is used for this adjustment. BPM is a collection of activities with the usage of methods and software to develop essential business processes. These essential business processes are being managed and continuously enhanced. The Business Process Management Suite (BPMS) is a tool that provides possibilities to support these activities.

**Construction model (CM)**

It is possible to describe an organization through essential transactions with the construction model of DEMO in an abstract form.

**EPC**

Event-driven process chains are regular in ARIS. EPC displays the activities of processes in a sequence.
1.3 Problem definition and questions

“Complexity is on the rise and is affecting all sectors. For many companies, product and service portfolios are growing explosively, processes and systems are proliferating, and organizational structures and processes are becoming convoluted and problematic.”[24]

Johan Aurik, April 2008

The problem of increasing complexity in and out of organizations needs to be gripped properly and continuously. The large organization has a large complexity with its ongoing growth of success. To understand the organization properly, one has to have support. Proper understanding provides proper decision making to avoid unnecessary risks for the continuity and the revenue of the organization. The problem definition of the research is towards the increasing complexity of organizations. How can this complexity be reduced and coped with? Organizations try to cope with its complexity through the use of methodologies. However the methodology used at CD, ARIS, proves to be insufficient to comprise the entire organization of RWS. This is the reason why the research project is performed in the first place. The focus of the research project is to create a formal junction between two methodologies, mainly ARIS and DEMO.

There are 4 main questions in this research, which will be answered in this paper. These questions are further detailed with additional questions that are also addressed below.

1. Is there added value in the linking together of DEMO and ARIS for the solving of organizations’ problems and for the reaching of organizations’ goals? What are the possibilities for this junction?
   - What are the advantages and the disadvantages?
   - What are the consequences for the organization?
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2. What is an appropriate way to determine (essential) business processes?
   - Can processes be performed tacitly?
   - Is there a method to determine the process?

3. How could one gain insight into the information architecture of RWS?
   - Does the enterprise architecture model of RWS (EAR) help?
   - Is there a better and quicker understanding of RWS with EAR?

4. Does the test case used for the illustration of the theory add value towards the end result?
   - What are important characteristics of ARIS and CD?
   - Which BPM functionalities are relevant to gain essential business processes?
   - What are the important characteristics of DEMO?
   - Should we pay attention to target groups?

These questions will be elaborated in the rest of the report and answered in the conclusion.
1.4 Research hierarchy

The next tasks are performed to accomplish the research goal and questions.

The thesis proposal

The thesis proposal is a short paper that displays the main problem definition of the research.

The thesis assignment

The thesis assignment is performed as a consequence of the thesis proposal and is focused on the SWOT analysis of the DEMO and the ARIS methodology. Relevant literature is consulted as an addition to the value of the problem solution.

Model

A theoretical model is formulated to define the solution.

Examination at the Corporate Dienst

The ARIS and the DEMO methodology are examined during the research project at the Corporate Dienst of RWS. The methodologies are closely analyzed with the SWOT method as way to provide a bridge of cooperation between DEMO and ARIS.

Case study

ARIS is used at the Corporate Dienst and plays an essential role in BPM. A process of Rijkswaterstaat is taken to test the research the methods and the conclusion of the thesis assignment.
1.5 Cause for the research

Large organizations are suffering whether they should cooperate and collaborate with other organizations or not. Cooperation is a concept that is much talked about and also acknowledged, but difficult for organizations to cope with. Organizations that are willing to cooperate with another must initially be examined and mapped thoroughly [18].

Some forms of cooperation are [16] [17]:

- **Merge.** The joining of the business organizations
- **Take-over.** The business organizations are assigned to another organizations.
- **Joint venture.** Business organizations make cooperation associations to work together in order to undertake an activity.
- **Outsourcing.** This is the delegation of an activity towards another organizations that is specialized in that area.
- **Shared service center.** Organizations will work together when the advantages are clearly understood and acknowledged.
- **Strategic alliance.** A formal relationship between organizations is pursued to gain a common goal, but these organizations remain independent at the same time.
Elsevier states the following:

“Cooperation in an organization can be studied empirically by examining the routine transfers or exchanges among members of various kinds of resources. We argue that local regularities in the form of these transfers and exchanges shape the structure of cooperation. Using a case study of resource networks in a corporate law firm, we model the structure of cooperation in a specific work environment, one that is characterized by multifunctional and sometimes multidisciplinary work groups in which status competition is argued to be a particularly strong motivation driving participation. Specific statistical tools, p’ models, are used to identify local regularities in the interplay between exchanges and transfers of three types of social resource (coworkers’ goodwill, advice and friendship). We propose that these regularities help to provide structural solutions for the problems of collective participation and status competition in such organizations.” [25]

It is important to research the organizations meticulously to have a cooperation that is accurate and strong. The researcher is obliged to provide a vision of the risks, advantages and the disadvantages in a proper report. Large organizations that consist of many divisions must cooperate together in order to increase quality and revenue.

This paper is a vision for the upcoming cooperation of two divisions of Rijkswaterstaat:

- Corporate Dienst (CD) in Utrecht
- Data & It Dienst (DID) in Delft

The DEMO methodology is also used by DID, Data-ICT-Dienst, which operates on a national level and is focused on the area of expertise of data and ICT. This division of RWS, which also is a national service like CD, is accountable for the gathering, management and provision of data, and for the management and development of ICT to support the processes. [1] In the past all the divisions of RWS used different systems to perform the equal activities. The division DID try to centralize all these systems so that the activities could be performed on a consistent level.
The availability of knowledge and expertise should be broadened throughout the entire organization to accomplish cooperation.

Corporate Dienst uses ARIS as the describing methodology of the (business) processes. The DID uses the DEMO methodology with the Troux tool to describe the (business) processes. It is essential for the divisions to work together on a formal level, because it will increase the quality and the problems can be acknowledged almost immediately. There is also a better understanding about the several responsibilities of each organization. The risk of re-doing certain tasks is greatly reduced.

To link DID with CD and vice versa, one need to focus on the hypothetical cooperation between the ARIS and the DEMO methodology.
2 Context of the research

The Directorate-General for Public Works and Water Management (Rijkswaterstaat) is an organization that exists for over 200 years now, founded in 1798. Rijkswaterstaat (RWS) is highly responsible for the actual execution of the Dutch Ministry of Transport, Public Works and Water Management; it builds, manages, develops and maintains the main national infrastructural networks; the organization is therefore a very important service-providing component of the government in the Netherlands. [4]

RWS attempts to reach the following objectives in the Netherlands:

- Assurance of safe and unobstructed traffic movement
- Construction, management and maintenance of the main highways and waterways
- Protection against flooding
- Assurance for a sufficient and qualified water supply
- Generation of reliable and user-friendly information

With an annual expenditure of approximately 4 billion Euros, a total amount of employees of nearly 9,500 people, flood defenses of roughly 300 km, main rivers or canals of 850/350 km and main highways of 3,000 km, RWS tries to maintain its objectives [14]. RWS wants to reduce the number of employees and at the same time tries to maintain as well improve as the quality deliverance of the organization.

\[4\] Still growing
RWS is a large and complex organization that is responsible for delivering service to the citizens in the Netherlands. The management of the organization is evolving towards a more public oriented manager of the infrastructure in the Netherlands and aims at becoming a union in their way of working (divisions have to cooperate with each other to conclude a project of RWS successfully). The organization has been trying to structure the organization by splitting it up into several divisions. From the organization chart (figure 1) above the conclusion can be withdrawn that RWS is differentiated into many sub organizations that are highly responsible for a particular area of relevance. The Corporate Dienst (CD) is a central sub organization in which supporting tasks of RWS have been accommodated. Furthermore the Corporate Dienst in Utrecht is divided into several departments.

CD supports the actual execution of all primary processes (bedrijfsvoeringsprocessen) within the Bestuur, Staf DG and RWS services (like CD), by delivering excellent service for lower cost. Financiele Diensten, a shared service unit of CD, has a department called BPS.

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BPS (Beheerorganisatie processen en systemen), a central section of the Corporate Dienst, is responsible for simplifying, uniformizing and standardizing of all processes and systems of all divisions of RWS. The processes of RWS can be characterized in 3 main processes:

- **Supportive**
- **Operational or Primary**
- **Strategic**

BPS aims at providing effective and efficient processes application and systems towards the users of RWS by supporting the daily use of the system and extracting quality improvements of the processes and systems.

**UPP, Uniform Primary Processes**, a cluster within BPS, describes the primary processes as a way of adapting a uniform way of working in the organization of RWS. Primary processes are lined up across the customers and the main activities of RWS are accomplished through these processes. The existence of RWS is based on the primary processes. Furthermore, the physical products or services are the actual products of RWS; these products are achieved through the primary processes. These are:

- Network management
- Realization public works (still in the make)
- Traffic management highways
- Traffic management waterways
- Water management
- Maintenance public works
- Policy development and facilitation
- Licensing and enforcement

The primary processes are extracted from and closely related to the three main networks of RWS (the main highways system, the main waterway system and the main water system).

6 Still under construction

7 The primary processes are extracted from the main networks.
UPP was a project within the BPS for uniformizing the primary processes, but at a certain point during the project it was decided to include UPP into BPS. UPP guarantees the following:

- UPP provide a basis for the organization; there is more insight into the several responsibilities and created products.
- UPP helps to make Rijkswaterstaat more recognizable for the customer/citizen; there is more visibility.
- UPP facilitates the way of working.
- UPP is open-minded for the employee’s professionalism and initiative, within conditions of the organization.
- UPP supports Rijkswaterstaat in their goal to be a learning and an adapting organization.
The function (behavior) of RWS is displayed in the chart above. On the highest level the management team (DT-RWS) is responsible for managing RWS, so that the organization can meet the need of its users. DT-RWS consists of the DG RWS (directorate general) as well as the regional HID (Head engineer director) and the Raadgevend DT (advisory direction team).

Generally the Bureau DG consists of the communication and strategy towards the management of RWS. Communication and strategy are main foundations for assuring the corporate communication and strategy, for continuity and quality increase of RWS.

The department Control & Toezicht (C&T) is mainly engaged in the process of independent control. C&T focus on establishment and monitoring of business management, the budget management and the management cycles by monitoring the performance through control and audit. This particular department maintains 3 main tasks namely:

- Strategy & Development
- Management Control
- Risk management & Control

RWS is the national traffic manager, who prioritizes and directs the primary processes through the fact and vision on the capacity and development of the networks (Netwerken). Netwerken (dry and wet) supports the management team (Bestuur) with the management and development of the networks in the Netherlands.
The *Produktie (production)* unit supports the management team with the construction, management, maintenance and the monitoring of the performance of the primary production of the networks of RWS. *Inkoop (purchase)* is on the fully dependant on the market-state and responds to the practical fulfillment of the public interests.

Human Resource Management (HRM) is the unit that primarily strives to gain quantity and quality of the personnel of RWS. Consequently RWS can function in a proper way in order to realize it goals set.

Information forms the knot between projects, primary processes and business management. The department I&R (Information & Report) provide strategic advising on information provision on RWS as well as for ICT. I&R performs 3 main tasks:

- Information provision towards business management
- Information provision towards the networks of RWS
- Management advising about information and ICT

The *C&T, Netwerken, Produktie, Inkoop, HRM, I&R* are the components of the RWS staff.

Due to the extent of the organization of RWS, it is clear that there is need for structure and guidance to conduct its operation.

The construction is developed according to the enterprise architecture framework of RWS, EAR.
2.1 Eventdriven Process Chain (EPC) in the ARIS platform

Currently the Corporate Dienst (CD) in Utrecht makes use of the ARIS platform in their organization. The primary processes of Rijkswaterstaat are described and registered in ARIS, through UPP. The ARIS methodology that stands for architecture of integrated information systems, offers many functionalities for describing organizations and their applications. [7]

More purposes of ARIS are:

- Centralized storage and management of processes, system landscape and the structure of an organization (Rijkswaterstaat).
- Communication through processes and information towards all employees; making this available.
- Centralized storage for all relevant documentation with respect to processes.
- Support of ERP (Enterprise Resource Planning).

BPS, department for the management of processes and systems ensures that generic and specific processes are modeled with EPC, which is a tool to model all processes of RWS, in order to be managed and consulted. The dependency and relevance of ARIS is very high, because the uniformizing of the primary processes has been centrally stored in ARIS, while the information on decentralized levels has been removed. The supporting services of Rijkswaterstaat are well supported by ARIS in EPC (eventdriven process chains), which are sequences of the supporting processes. The CD mainly focuses its attention towards the business area of RWS, in particular at the service provision (dienstverlening).
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RWS is a constantly changing area and it is important that the changing doesn’t influence the forthcoming results of the department.

Prof. Scheer, founder of IDS Scheer, which is market leader software, solutions and services for Business Process Management for organizations and government agencies around the world, has designed ARIS. The structure of organizations as well as the procedure structure can be modeled and documented with the ARIS concept, with the model types available within. The processes in Rijkswaterstaat can be subdivided and placed in 6 layers according to ARIS:

- Organization environment
- Process-areas
- Main processes
- Process clusters
- Processes
- Detail information per activity

The organization gets described in the first layer; there is a clear disjunction between the primary and the supporting processes. The different primary and supporting processes of the several departments of the organizations are being detailed; the context parts are being detailed in the second layer. On the third layer, every main process for every process-area is being registered. The main processes are divided into detail processes and are chronologically described in layer 4 and 5. The modeling-concept from layer 1 till 5 is considered “lean and mean”. Important details for actual use of processes are concentrated in layer 6, the Function Allocation Diagrams (FAD’s). In the last level all the relationships between objects and each activity is displayed.

IDS-Scheer claims that through the usage of ARIS, all processes within an organization can be controlled. In addition the methodology provides the following advantages [12]:

- Clear and graphical representation of complex processes and interactions across the boundaries of the organization
- Supports the quality and the cost of organizations
- Competitive advantages resulted from continuous improvement and cost control.
ARIS platform is the tool for managing (business) processes, such as operational processes and the affected target groups in the organization/company are supported through ARIS. Organizations are able to cope with the continuous changes throughout the whole lifecycle of the processes, through the usage of ARIS. IDS Scheer created AVE (ARIS Value Engineering) together with the experience gained from former diversified projects in different areas and the best practices with the ARIS platform. AVE is transparent because it can be used across a wide range of areas and this transparency guarantees fast growth of knowledge and also reduces uncertainty in the planning. The former experiences reduce project risk and allow rapid, low-cost implementation of customized solutions, enabling a faster return on investment (ROI) according to IDS Scheer. Because RWS is a vast customer of IDS Scheer, this constant quality control is an excellent way of emphasizing the added value of the platform [10][12].
2.2 The Enterprise Architecture Framework of RWS

Architecture is mainly focused on the business and IT areas of organizations. These organizations are highly complex. Architecture frameworks have been developed in the previous decennia to be able to maintain the complexity of these organizations. An architectural framework has a clear and essential part in the important subjects that are to be discussed in the organizations. The framework can be seen as a classification of the several important information areas of the organizations. The applicability is not dependant on the hierarchy of the framework; the outcome is simply dependant of the subject statement.

The framework being used in RWS is called EAR, Enterprise Architecture Rijkswaterstaat. EAR can be seen as a united and consistent collection of principles, starting points, rules, guidelines and standards. It is a mayor remedy for strategic management and changes, due to the fact that the conditions of the organizations regarding the information supply, the information systems and the technical infrastructure are described here. The framework has the main objective to provide a junction between business and IT, so that the efficiency and the effectiveness of RWS can be enhanced.

The architecture principles (principes) consisting of goals, strategies, management and trends, tend to conduct the enterprise architecture towards a more managerial scope. These principles are a consequence of the vision and the strategy of RWS and ICT (why –question). The products and services, which are resulted from the processes of RWS, are located in the business architecture and are described in a DVL (“Dienstverleningsmodel”). These principles decide how to realize the ICT projects. The editing and the managing of EAR are concentrated on the “what” question. The functionality, the technical assertions and the security inputs are to be found in this layer. The “with what” question is application oriented; with what will the realization be a fact. Every project has period of time to conclude; this is comprised in the “when” question.
The team of EAR contains architects, who are involved in different projects of RWS. The knowledge gained from each project is gathered and used to support the upcoming projects. Therefore the enterprise architecture is constantly augmenting and enhancing.

Figure 4 displays the framework of RWS. The framework consists of boxes that cover elements that are closely related to each other. The organization of RWS can be placed in the boxes according to the close relationships of its elements.

Processes of RWS can be placed in an area, either in a box or on an edge. The traffic management of the Hoofdwegennet is embedded in the “wat” area of the framework, “Dienstverlening”. Dienstverlening is the area that is mainly responsible for the delivering of services. However the system boundaries are merely conceptions and not anchored in the organizations. Actors can lie within the RWS boundary or can be external. Incident management is a topic that will be addressed in this report and lies in the same box as the management of the Hoofdwegennet. IM will be explained in the upcoming chapters and its relationship with the goals of RWS.
3 ARIS, RWS

3.1 The EPC model of IM

Incident Management is a large area that can be used in almost every context. The focus of this paper is on the incident management of the VMHWN. There are 2 parts of IM on the main highways:

- An infrastructural incident (this is the malfunction of the infrastructure; road is broken, traffic-light malfunction etc.)
- A traffic incident (this is an actual accident on the road)

There is less organization needed concerning an infrastructural incident, because not every helping service needs to be contacted. When a simple crash barrier needs to be restored, there is need of a contractor to do so. However if for instance a certain complication has originated on a main road, it must be removed as soon as possible for the total usefulness of the road. There are many parties involved in this situation. Both types of incidents are merged together, whenever an infrastructural incident causes a traffic incident. The following tasks of IM are mainly focused on both types of incidents.

The construction model of IM is divided in seven main tasks:

- Monitoring the incident location
- Taking of safety measures (whenever an exceptional situation occurs)
- Supporting emergency services (ambulances, police etc.)
- Adjusting DVM\textsuperscript{8} (dynamic traffic management) measures
- Traffic diversion (the remaining traffic is being redirected). Adjusting the flow of the traffic (“doorstroming”). *
- Put away and clean up
- Adjourn measures

\textsuperscript{8} Dynamisch verkeersmanagement
These seven steps are carefully followed to solve the problem of a traffic incident at the road. The traffic image is being monitored before these tasks can be performed.

The actor roles that execute these tasks are mainly the:

- Road Traffic Leader (“wegverkeersleider”, WVL)
- Road Inspector (“weginspecteur”, WIS)

The first step of the entire solving is the receipt of an incident at the WVL. The rest of the actor roles (GHOR, Police)\(^9\) are performed through extern actor roles, they do not belong to this process. But the importance of these actor roles will be described in relation to IM of the VMHWN. These external actors will be called the IM-partners of the process. WIS has the responsibility to execute the first task, namely taking safety measures. This process should be adjusted with the WVL and the Police however.

The safety of the actors must be guaranteed before they can execute any taken measure whenever the incident (exceptional) occurs. This is the first and most important measure that must be taken before the other tasks can be performed. The entire incident location is therefore monitored and observed.

The police have 2 processes to perform:

- The area of the incident is demarcated
- And the traffic must also be circulated in order to guarantee continuance and safety for the road users.

The size of the incident location is constantly guarded to prevent RWS employees to enter. All these tasks are performed according to the direction rules, stored in documents of RWS (“criteria OvD-RWS”\(^10\)). The remaining tasks (adjust the traffic flow, traffic diversion, put away and repair, restore and clean up) are done in adjustments with these actions (safety measures, traffic circulation). When all the safety measures are taken, the other executing (supporting) processes can be started.

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\(^9\) Gemeenschappelijke hulporganisaties (ambulance, police, fire brigade etc)
\(^10\) opschalingcriteria Officier van Dienst (OvD), veiligheidsmaatregelen (6V’s): veiligheidskleding, verkeersregels, vrije ruimte, voertuig als buffer, verkeerssignalering, vrijhouden aan – en afvoerroute.
Emergency services are required at the location, whenever an incident occurs on the road. It is essential to guide these emergency services as good as possible, to complete the solving process of the incident.

The WIS has the responsibility to adjust the flow of the traffic, and this task is closely adjusted with the police process, traffic circulation, to increase the traffic flow as good as possible (traffic jams must be avoided).

Special care must be given to the cooperation of the WVL with the contractors that must be hired according to the calamity.

The placing of screens for instance, so that the location can be viewed clearly is a way to increase the traffic flow on the incident road. The process “adjust the flow of the traffic” should be in tune with the “hiring of contractors” according to the incident and also with the “traffic circulation” tasks.

DVM measures are carefully exploited ad hoc solutions for incident management and these measures are adjusted whenever all the previous tasks are already done.

The executing task (traffic diversion) is an instruction given by the WVL to the WIS to take measures to perform the task. Incident Management is an area, which is closely researched and experts are always trying to contemplate about of all kinds of incidents to provide solution schemes accordingly. These experts are well known (scenario’s) with the different consequences of incidents and can evaluate what measure can be taken to what incident on the road. “Werk In Uitvoering” (WIU) is a task that could be postponed in order to help the execution of the “traffic diversion” on the diversion route. The process “traffic diversion” is executed according to the decisions made by the WVL. WIS has to adjust its responsibility with WVL, contractors and the Police to normalize the traffic situation. Other tasks that must be taken into account in this executing process are:

- Traffic circulation
- Hiring of contractors according to the calamity
- Supporting WIU
"Put away and repair" is a process that is done according to the notification of the incident to CMI/CMV\textsuperscript{11} or STI\textsuperscript{12} (trucks). Incident about light vehicles (cars etc.) are notified to CMI/CMV and heavy vehicle notifications are given to STI. If the traffic emergency room (verkeerscentrale, VC) knows about the incident beforehand, this is being forwarded to CMI/CMV or STI.

A stocker ("berger") is appointed to the incident location together with the WIS after the observation of the situation. After making an inventory of the possible placing of the materials, WIS adjusts with STI which measures must be taken to guarantee maximum traffic flow.

There are three kinds of methods to stock the materials after the work has been executed:

- Normal pace, there is no damage
- Accelerated pace, there is extra damage to the vehicle
- Postponed stocking, right after the peak hour

WIS is responsible for the stocking and repairing of the incident and is executing this process. Other involved parties are WVL, stocker and the fire brigade when more help is necessary. An employee at STI has a consultative role at the socking of the vehicles and their freight with regard to objectives of the insurers.

The process “Put away and repair” has to cooperate with the following (external) processes:

- Protocol of notification
- Methodologies for stocking
- STI agreements

The last but not the least process is to restore and clean up the disorder. The VC gets a notification of damage of for instance the road (public property). According to this notification, help is necessary of contractors. Essential materials and enough workmen are acquired to perform the chosen methodology, in such a way that there is as less as possible traffic hindrance on the incident location. WIS who is responsible is performing this process of restoring and cleaning up. An important cooperation partner of this actor role is WVL.

\textsuperscript{11} Coordinating
\textsuperscript{12} Salvation Transport Incidents
This process is should work together with the following processes:

- Traffic diversion ("doorstroming van het verkeer")
- Supporting WIU

The OvD will have a coordinating role and guide WIS to perform the tasks whenever the criteria of the OvD are apt.

The following figure displays IM in the EPC description form.
Coupling of DEMO and ARIS

EPC of Incident Management:

![Diagram of EPC Incident Management]

Figure 5 Incident Management according to EPC
The yellow boxes display an actor role and the gray boxes an “or”. Two actor roles are considered in this activity and at the end of each activity there is the beginning of the next activity. The figure carefully displays the responsibilities of each relevant actor role. Every activity that is displayed under a yellow box is considered done by that actor role. The green boxes are the activities and the red boxes display the input for (outcome = income) of the activities. The essential activities are illustrated with another EPC model with the relevant actors as seen in the following figures. Only few activities of IM are chosen to be displayed in EPC’s to make an excellent gesture in the conclusion as well in the next chapter. The next model is the detailed representation of the process “taking safety measures”.

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Taking safety measures:

**Figure 6 taking safety measures**

Figure 6 is the EPC of the process, taking safety measures.
Traffic flows:

Figure 7 traffic flows

Figure 7 is the process of increasing the traffic flow in as less time as possible. The several sequential measures are therefore shown after the notification of the incident.
Coupling of DEMO and ARIS

Diversion of traffic:

Figure 8 displays the sequence of the diversion of the traffic flow.
Put away and repair:

- Stocker summoned
- Explore location with stocker
- Inventorise areas for equipment
- Formulate plan for stocking
- Agree plan with OVD
- Adjust plan with WVL & stocker
- Operate emergency services
- Execute stocking
- Stocking executed

**Figure 9 put away & repair (stock)**

Figure 9 displays the stocking of all the material that was used to repair the damage.
Figure 10 restore & clean up

Figure 10 is the explanation of the restoration and the cleaning up of all the material after these activities.
Coupling of DEMO and ARIS

Way of working of OvD:

![Diagram of the way of working of OvD]

Figure 11 way of working of OvD

The responsible actors of IM are displayed above. In short, the OvD signifies the process of managing incidents. WIS formulates a plan to handle the incident at the given locations. The OvD informs the concerning traffic central (VC, verkeerscentrale) with agreement with the WVL and validates the IM plan. WIS again executes the plan with agreement with OvD at a constant rate.

IM will be displayed in the DEMO construction model in the next chapter.
4 DEMO, TUDelft

4.1 Introduction

The DEMO methodology consists of the construction model (CM). It is possible with the CM to illustrate the organization in terms of actors, transactions and information streams. IM will be illustrated through a construction model according to the DEMO methodology.

4.2 The applicability of DEMO

The DEMO methodology is designed and developed by Prof. Dr. ir. Jan L. G. Dietz, who is an academic at the Technical University in Delft designed and developed the DEMO methodology model. The model, which is particularly developed to model organizations, is being used within reasonable limits in the Netherlands. DEMO (Design Engineering Methodology for Organizations) is a methodology that is focusing on designing, construction and connecting organizations together. Altogether DEMO delivers support towards organizations being constantly in change.

The DEMO methodology is being taught at the University of Technology in Delft, at the Hogeschool in Utrecht and also at Capgemini.

The essential structure of the distinct business processes and the products (services), delivered by a business, are according to DEMO quite stable. However the difference lays in the way these business processes are produced and is partly influenced by the constantly changing ICT. [2]

Consistent with Professor Jan Dietz, the DEMO methodology is comprehensible, modular, complete, integral, consistent, and unbiased and has low costs, whenever used.

The decision-making in the organizations is eased. Processes within organizations are seen as filaments, which are composed of transactions, which contain commitments. This modular and leveled structure provides a perfect connection with the component-based system development. [3]
A transaction in the demo methodology contains coordination and production actions, which leads to one (1) production fact. It is a generic building block for organizations and can be used as a template for designing processes, because it provides assurance that actions or data will not be ignored or forgotten in the organization change.

Some actions in organizations for instance are done in a tacit manner and these actions are regularly forgotten when the change take progress in the organization. DEMO provides a complete and clear definition of competencies, authorizations and responsibilities of the composition of the organization. Relevant information regarding the need of actors is also given.

DEMO encountered three kinds of production-actions, the essential or business actions, the informational actions and the documental actions. The organization is divided into the B-organization (business layer), the I-organization (information layer) and the D-organization (documental layer). The unambiguous link between the 3 divisions makes it possible to manage the redesign and the reassembly of the organization. The several layers are linked together, the information layer supports the business layer and the infrastructural layer supports the information layer. Each process change in the organization can be placed in one of the three layers. The different models of DEMO are perspectives of one metamodel. The impact of the changes in one perspective on another perspective is complete and visible, because of the mutual consistency of these perspectives.

The methodology of DEMO delivers compact and reality-based models and claims to cause a decrease of 30% on the project costs.

The business layer is the most essential layer in organizations according to the methodology; insight into the business layer is the starting point in designing and constructing the organization.

DEMO is a methodology for designing, categorizing and reciprocal connecting of organizations.

In this process communicational actions play a central role, because communication is essential for the forthcoming of organization’s businesses. [6] Agreements [1] made between employees, customers and suppliers are a result of communication; the acceptances of delivered results are also the outcome of communication. Each transaction consists of 24 actions.
Coupling of DEMO and ARIS

Important ones are:

- Request
- Promise
- State
- Accept

The next section provides the construction model of IM in order to compare the previous obtained EPC models with it.
4.3 The construction model of Incident Management

In this chapter Incident Management will be modeled by means of the DEMO methodology. Incident management consists of a sequence of activities that need to be addressed. The essential activities are captured in the construction model of the DEMO methodology.

The activities of IM are:

- Monitoring incident location
- Taking safety measures
- Supporting emergency services
- Adjust DVM measures
- Divert/redirect traffic
- Put away & clean up
- Adjourn measures

The construction model in developed with the stated activities of IM. These activities are translated as transaction according to DEMO. This is shown in the table below.

<table>
<thead>
<tr>
<th>Transaction type T#</th>
<th>Result type R#</th>
</tr>
</thead>
<tbody>
<tr>
<td>T01 monitoring incident location</td>
<td>R01 Incident location monitored</td>
</tr>
<tr>
<td>T02 taking safety measures</td>
<td>R02 taken safety measures</td>
</tr>
<tr>
<td>T03 supporting emergency services</td>
<td>R03 supported emergency services</td>
</tr>
<tr>
<td>T04 adjusting DVM measures</td>
<td>R04 adjusted DVM measures</td>
</tr>
<tr>
<td>T05 diverting traffic</td>
<td>T05 diverted traffic</td>
</tr>
<tr>
<td>T06 putting away &amp; cleaning up</td>
<td>T06 put away &amp; cleaned up</td>
</tr>
<tr>
<td>T07 adjourning measures</td>
<td>R07 adjourned measures</td>
</tr>
</tbody>
</table>

*Table 1 transaction-result table of IM (TRT)*
The construction model of IM is developed according to the TRT above. Every transaction and its result is stated in figure 20. The fixed incident location can be seen in figure 12. This transaction is the general transaction of incident management. CA01 is the initiator and A02 is the executor of the transaction T00 (CA01 asks A02 to perform T00).

![Figure 12 Fixed incident location](image)

This transaction is displayed to express the fact that the situation is completed in the end. The 7 activities of the IM are displayed in single actor-transaction order hereafter. This is done to create a clearer outlook of IM with the construction model.
Coupling of DEMO and ARIS

The construction model of Incident Management:

Figure 20 CM of IM

This model is the same IM process but displayed in the construction model of the DEMO methodology. Incident management of traffic is distinguished in the essential transactions.

Two more transactions are also part of the process, because of the importance these actors, namely the traffic law maintainer and the infra observer. However these two are not added to the model. We are dealing with a situation in real time, and because of that ad hoc decisions must be taken to remedy the problem within minimal time and accurate measurements.
The traffic law maintainer takes care of the fact that everything is done with close focus on the law. The observer of the infrastructure is mainly responsible for a global overview of the status on all infrastructures constantly. The occurrence of incident A on road A must not lead the negligence of incident B of road Z and must be managed at the same time or as soon as possible. These transactions are therefore very essential, but not included in this process boundary.
5 SWOT: EPC and CM

The EPC model and the CM model of IM will be compared and elaborated on, in this chapter according to the SWOT [33] analysis.

5.1 Construction model of IM

DEMO distinguishes the organizations in three areas:

- B-organization (business)
- I-organization (information)
- D-organization (data)

DEMO provides the business level of the organization according to the SWOT. This is a compact and abstract structure of the organization with its essential tasks. The CM model of IM is displayed in terms of actors and transactions.

![Figure 21 Initiator - transaction -executor]

The initiator initiates the transaction and the executor executes it. The executor therefore has a little black box that shows its role. There is no detail and the claim is that understanding should be possible without further detail of the several processes. IM is distinguished in seven (7) essential tasks after a close look at the CM model. IM is a short example of a Construction model in DEMO and could be understood without further explanation. When a process is larger with many processes that are linked together and extremely complicated, the DEMO construction model is an excellent tool to display the deep (abstract) structure of the process.
Coupling of DEMO and ARIS

A large company is proven to be complicated and in need of structure for an accurate overlook of the entire organization. The construction model of IM is simple to overlook and there is almost immediate understanding of the process. The processes of the construction model can all be mapped in the business organization, the B-layer.
5.2 The EPC model of IM

The EPC model of IM has seven essential (business) processes and some are further detailed with EPC, which displays all the activities. The EPC model of IM gives a clear understanding of the actual executing of incident management of road traffic. However there is no visibility of the actor roles and its responsibilities. However dependant on target groups, to gain more insight one has to dive deeper into the several activities of IM. When a managerial target group tries to understand the description, it proves to be inflexible, not accessible for change. The EPC model is further detailed, and these processes can be mapped in the I-organization and the D-organization.

As the construction model of DEMO is a clear explanation of the mere actors and the transactions, this is a well-suited model to provide the managerial target group the much-needed understanding. The importance lies in the linking of the DEMO and the ARIS methodologies to provide a better methodology that can cope with the several (upcoming) problems. An exact explanation will be given in the next section about this particular subject.
5.3 A suggestive solution

Rijkswaterstaat is a very large organization with a complexity of its own. It is divided into many divisions; one of them is the Corporate Dienst in Utrecht. The Corporate Dienst is the division that lies central among all the other divisions and takes care of the description of the essential processes of the entire organization. CD provides a detailed overlook of the responsibilities of the several actor roles in RWS.

ARIS is a methodology that is used for the provision of understanding of the responsibilities and the tasks of all RWS employees. The idea is to create a better understanding towards the actual executors of the processes of RWS. There are target group that look upon these EPC descriptions. Every target group has its own notion of the EPC’s. The descriptions are (very) detailed and more focused on the understanding of the several executors of the processes. The large descriptions are closely related with each other and in this way very complex. The executor already has a notion of its responsibilities and tasks and will understand its own process description.

When for instance another target on a more managerial hierarchy area tries to gain understanding from these descriptions, there will be a problem. The target group is situated on a higher level than the executor and is in need of a clear understanding on a less detailed level. The thesis assignment elaborates on the pitfalls of the EPC method.

The organization of RWS is distinguished in three (3) layers, which is done according to the BPM of ARIS:

- The strategic level
  - Strategic means the actual reaching of long-term goals. This level is merely found at the highest managerial level of the organization.
Coupling of DEMO and ARIS

- The tactical level
  - Tactical is situated just below the strategic level. This level is more focused on the concrete planning of the several solutions and problems.
- The operational level
  - This level is the executing level of the organization. All the plans made in the levels above are executed in the operational level.

![BPM levels](image)

**Figure 22 BPM levels**

IM lies in the operational level of the organization of RWS and is described in ARIS. This description is not adequate to suffice the understanding of a target group that is situated on a managerial hierarchy.

To provide a link between the ARIS and DEMO methodologies it is essential to initially establish a common understanding of their characteristics. The methodology of ARIS is elaborated on all the levels of an organization according to BPM. However the highest level (strategic) proves to be less clarifying as perceived from the previous study in this thesis project. The tactical and the operational are more detailed and provide more understanding.

DEMO on the other hand is merely focused on the business (strategic) level of the organizations according to its construction model. The information level and the data level are purposefully neglected. If an organization merely makes use of only one of these methodologies, this will prove to be insufficient and unsatisfactory for its entire outcome and quality.
Coupling of DEMO and ARIS

The SWOT [33] analysis provided a detailed overview of the deficiencies and advantages of ARIS and DEMO. Organizations can use DEMO to:

- Begin modelling business processes
- Provide the (business) process analyst sufficient assistance to identify (business) processes

DEMO provides a high level structure whereas ARIS focuses on a functional analysis of the organization. At first the models of the organization are modeled in DEMO, and further developed in ARIS with the EPC tool. The activities of an organization need to be divided in essential processes in ARIS. This is a difficulty for the process analysts, because ARIS does not have a method to determine the essential processes.

The EPC of Incident Management provides an overall picture of the activities that take place in this process. The concrete outcomes of every activity provides means for accurate monitoring and quality control of the process IM. The EPC model however does not give a solid structure so that the process changes surprisingly if its way of working changes. Since all the activities are sequenced, the entire meaning of the process would change if some activities would be shifted in a different way. In the process of ordering a pizza, the deliverer has to deliver the pizza first, for the customer to accept it afterwards. If this sequence changes, the entire process of ordering a pizza changes as well, but the core of the organisation remains the same. This issue in the process indicates that EPC is not a qualified method to overcome changes in the area.

The paper of Strijdhaftig [34] displays examples of a deliberate coupling between an EPC model and a DEMO construction model. The author divided the paper in 3 questions:

- Can an EPC model be substituted by a DEMO model?
- How can one model be fitted into the other model?
- Does the combination of both methodologies provide an added value? And what are the rules for combining both?

The answer of the first question is negative. The second question provides means for linking the methodologies together. This is shown in a few examples. The linking together is possible, however changes needs to made in
both models, to consistently couple them together. The construction model of Incident Management is shown in figure 20. The EPC model can be seen in figure 5. The DEMO model has to provide an abstract overlook of the process Incident Management, whereas the EPC model should be a detailed model of the process. The coupling of these two models is a fact, after making the models consistent with each other. The conversion of the models is seen in [33] and [34].

The EPC model is focused on the detail, while the construction model is displaying a vast structure of the process. Incident Management is a simple example and the EPC is simple. The EPC model of Incident Management is simple and one can understand it with some effort. And the detailing of each activity add to the understanding. However if the process is larger, the EPC model is assuredly more complex and therefore does not give a proper understanding of the structure. As a way of providing structure and understanding, one has to couple both models.

Every activity of Incident Management is translated into transactions in the DEMO construction model. “taking safety measures” is used as an example highlight the coupling between ARIS and DEMO. The construction model of the process comes on the highest level and then it is further developed in an EPC model as seen in figure 23.
Figure 23 taking safety measures
Coupling of DEMO and ARIS

This is the overall idea of the coupling of the models. Not every transaction in the construction model needs to be detailed, some can be performed tacitly. Many on the other need to be detailed further and documented for a clearer understanding.

Picture 23 is mirrored in the B-I-D organization patron of DEMO, and interesting notions are encountered.

![Figure 24 levels according to DEMO](image)

The coordination steps of the B-organization are equivalent with the activities in the I- and D-organization. The information in the I- and D-organization is more detailed, because they entitle the EPC model. These further details are necessary for the process to be executed. In other words, to fulfill the promise of the process, one has to request for activities from the I- and D-organization.

Merging the methodologies will result into a vast methodology that covers all the three levels of the organization. Many already existing descriptions should be changed afterwards, but this is an indication to a better understanding.
5.4 A short example

The national airport of the Netherlands, KLM, signed a contract in 2004 to merge with Air France, the national airport of France. KLM used protos and DEMO to describe the organization.

The new company however, Air France-KLM, decided to use ARIS as the describing methodology of the entire organization. This meant that ARIS were adapted into the organization and Protos completely removed. The remaining methodologies (ARIS and DEMO) are used in the organization, in other words merged together. The company must be able to cope with risen problems and be aware of pitfalls regarding the merge of ARIS and DEMO. But Air France - KLM has no experience at all with the merged use of ARIS and DEMO.

The Corporate Dienst (CD) of RWS has that experience, because it has already been working with DEMO and ARIS. CD can help Air France - KLM to cope with problems by sharing experience. Both organizations can assist each other.
6 Conclusion & further research

The report presented a formalism that can be used to represent knowledge about organizations and their business processes. It also discussed a merged methodology that enables business analysts to go from high-level enterprise objectives, to detailed and formal specifications of business processes for realizing these objectives. The methodology can be used by an enterprise that wishes to develop a new business process, or alternatively model, document and formally analyze an existing process.

The figures in the previous section must be seen as an indication of the focus of two methodologies. There can’t be a conclusion by merely merging one methodology with the other. Important differences can be known however through these comparisons. The questions asked in the problem definition will be answered in this chapter, together with an end conclusion.

BPM focuses on the obtaining of essential business processes of the organization. There are guidelines to obtain the essential (business) processes, but not all processes can be captured through BPM and these could be performed tacitly. Both methodologies pay close attention to BPM to obtain essential (business) processes. Guiding principles can prove to be useful, but for the total gaining of essential business processes, there must be carefully relied on the common sense and the experience of the engineers. Principles are important for the engineer as rules for not deviating the common knowledge area.

To gain insight into the information architecture of the organization, one has to rely on its architecture framework. EAR is being used at RWS, and provides reasonable help at the appropriate moments for a better and a quicker understanding. The position of a certain process is well understood afterwards.

The test case used in this paper is the incident management (IM) of traffic management of the main highways (VMHWN). IM is closely clarified according to EPC model of ARIS and also according to the construction model of DEMO.

The DEMO methodology has a distinguishing powerful feature when compared with similar methodologies developed in other enterprise modeling projects.
Coupling of DEMO and ARIS

A business analyst is able to verify formally that each role responsibility is fulfilled and each constraint is maintained as a result of process execution. The verification techniques that are used in DEMO can be used in similar methodologies such as ARIS once formal models like that are adopted. This as an important contribution of this research.

There are several target groups that are in need of understanding the process descriptions. Is it important to pay attention to these target groups? This is a question that is important because the descriptions are made according to these levels. It is important to distinguish target groups in the organization itself. The important characteristics of the ARIS methodology being used at the Corporate Dienst are merged with the characteristics of the DEMO methodology. An entire new methodology will emerge that will cope with all the issues of the organizations. Change is inevitable afterwards.

The research for the merging of ARIS and DEMO should be continued, because many organizations are very eager to have a better understanding of these methodologies. Not only is the Corporate Dienst of RWS in need of help, but also Air France – KLM gives signals. DEMO has proven to be a vast methodology to provide a deep structure on a business level. ARIS is a methodology that is used at some large companies and there is need for a better understanding and coping.

The main contribution of our work is the use of methodologies from Computer Science for business process modeling and analysis. I strongly believe that the use of formal methods such as the ones discussed in this paper can be of significant benefit for business analysts. This paper demonstrated the fact that formal methods can be valuable in the domain of business modeling and analysis. The main advantage of formal methods compared with more informal approaches is that sophisticated business analysts can capture business knowledge in an intuitive and unambiguous way to use them. They can also be used to analyze processes in a formal way; this would have been impossible if the business analyst used an informal approach.
Several possible criticisms can be voiced against the use of formal methods in enterprise modeling:

- It is a lot of work to create a formal enterprise model initially. Additionally, it is hard to maintain it to retain consistency with the actual enterprise.

- The use of complex mathematical notation may put off the average manager, business analyst or user.

- Special skills are required (in this case, familiarity with ARIS and DEMO).

The first criticism is not really a criticism of "formal" enterprise modeling but rather of any kind of enterprise modeling. There is a price to pay for undertaking an enterprise modeling effort but we would argue that the long-term benefits would outweigh the investment in resources.

The second and third criticisms are valid. Formal tools such as the ones proposed in this paper are somewhat complex, and business analysts may not bother to become familiar with them, opting for more informal methods. This can be a problem with formal methods but only if the people advocating them are not careful. The solution lies in developing supporting tools that offer the possibility of working with formal and informal versions of the same concept. In this way, any business analyst will find the supporting tools attractive and easy to use, while more sophisticated analysts will be able to resort to the formal machinery whenever they feel that they will gain advantage from doing so.

As time goes by, even less formally inclined business analysts might also be tempted to invoke the formal functionalities.

The future work will have to concentrate on demonstrating that the proposed formal methods are useful in practice. In the spirit of the previous discussion, it is likely to develop a set of user-friendly supporting tools for our enterprise modeling techniques and methodology. In parallel the techniques should be applied to the modeling of large processes in a way to evaluate the methodology and quantify any benefits over other approaches.
Coupling of DEMO and ARIS

The techniques should also be extended to accommodate all features of the organization. Finally, the methodology must be extended to deal with the problem of business change and investigate what formal techniques and reasoning can be beneficial in this case.
Coupling of DEMO and ARIS

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