A Well-Founded Framework for Assessing IT-Systems by the Suriname Ministry of Finance

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Delft University of Technology

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by

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Preface

This report is the result of the thesis project I carried out at the Suriname Ministry of Finance. My gratitude goes to Professor Dietz for trusting me enough to let me conduct the project in a perceived less than ideal environment and the guidance he provided, in particular writing this report. I would also like to thank Director Adelien Wijnerman for providing me the opportunity for carrying out the project within the Ministry. During the execution of the project, I observed the urge for improvements within the Ministry. This in combination with the developed framework may be the start of a new way of approaching IT related aspects within the Ministry.

This report also symbolizes the conclusion of my study period. I started this period with great enthusiasm and expectations. After seven years I can only conclude that my expectations have been exceeded: I mark this period as formidable. Therefore, I wish to express my gratitude to the ones who have crossed my path during this period.

Family and friends, who have been there through thick and thin, in particular Lindsay, Pascalle, Razia en Wladimir.

Darryl and Marvin for being an example when I was just a naf first year student.

The VHL roommates for providing me with a home.

Gabor for being the irreplaceable 'study buddy': first year, first course, first practical assignment.

Joao for being the bottom of the ravine: a good friend, 'study buddy' and professional soul mate bundled in one.

Concluding, I would like to thank my parents, Jane and Ricardo, for providing me the opportunity and ingredients for seizing this period. This report, and if you wish this achievement, is for you!

June, 2008
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Abstract

The government of Suriname, like any other government of development countries, copes with a number of limitations. Among others, the government lacks of IT policies and IT awareness. The challenge for the Suriname government, and therefore the Ministry of Finance, is to obtain means by which IT policy and IT decisions are steered in a structured way. The main interest should be the acquisition of business and IT integration and the ability to control strategic changes within the organization.

The Generic System Development Process (GSDP)s is a relatively new approach on the development of systems. It focuses on business and organizational aspects of an organization as well as on the design and engineering process of developing target systems. In addition, the GSDP provides a sound definition for relevant aspects of the complete development process and an overview of relations between these aspects

The objective of thesis project is to develop a well-founded framework for assessing IT systems by the Suriname Ministry of Finance. The result is an assessment framework based on the Generic System Development Process. The assessment framework consists of an ontological and implementation model of the organization and a functional model of existing IT systems. The Design and Engineering Methodology for Organizations (DEMO) is used for implementing the ontological model. The theoretical foundation of this methodology is used for defining tables for expressing the implementation model of the organization and the functional model of existing IT systems. The functional model consists of consistency tables, which contains integrated information of an organization and the supporting IT system. These tables open discussion and form the base for a proper assessment of existing IT systems.

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Chapter 1

Introduction

This report is the result of a project conducted within the framework of the master thesis, which is mandatory in the final year of the master program Information Architecture at the faculty of Electrical Engineering, Mathematics and Computer Science of Delft University of Technology. The project has been conducted at the Directorate of Finance [1] of the Suriname Ministry of Finance.

1.1 Background

1.1.1 The Suriname Ministry of Finance

The government of Suriname, like any other government of development countries, copes with a number of limitations. Among others, the government lacks of IT policies and IT awareness. To support the Ministry of Finance in its endeavor to reduce some of the aforementioned an institutional strengthening program was executed. Within the framework of this program, the Department of Finance has carried out a number of projects with emphasis on business and organizational aspects and IT support. However these projects were (or are being) carried without sufficient coherence. For the design and implementation of systems by means of IT support this means a lack of coherence between business and organizational aspects on one side and information technology on the other.

Future programs or projects may concern strategic changes within governmental organizations. As a result IT systems may not only be used as support for internal operational processes within the organization, but also to support services offered to government clients (civil society and business). A well known example of such a phenomenon is E-Government. The challenge for the Suriname government, and therefore the Ministry of Finance, is to obtain means by which IT policy and IT decisions are steered in a structured way. The main interest should be the acquisition of business and IT integration and the ability to control strategic changes within the organization.

1.1.2 The Generic System Development Process

From [*Baldinger et al.*, 2004] and [*Dietz*, 2004]:
The need for business and IT integration within organizations is proven to be a necessity

[1] dutch: Directoraat Financien

for controlling strategic changes from an IT point of view. The Generic System Development Process (GSDP) focuses on business and organizational aspects of an organization as well as on the design and engineering process of developing target systems. In addition it provides a sound definition for relevant aspects of the complete development process and an overview of relations between these aspects

The objective of executing a system development process is to eventually implement or redesign a system. The GSDP refers to such systems as the **object system.** The system using the services of the object system is referred to as the **using system.** The object system may also be defined as the system supporting the using system. Considering the development process of IT systems, the object system and the using system respectively coincide with the target IT systems and the supported organization. Both the using system and the object system may be modeled on different levels of abstraction. The **ontological model** is the construction model of a system on the highest level of abstraction. It shows the essential construction and operation of a system fully independent of its implementation. **The implementation model** is the lowest level construction model. It can be directly implemented using the appropriate technology, such that it can become operational.

The **design process** of the object system is defined as the activity that starts from the construction of the using system, preferably from its ontological and results in the implementation model of the object system. The design process is divided in an **analysis phase** and a **synthesis phase**. The analysis phase is called **determining requirements**. The process of eliciting the requirements for the object system is part of this phase. The set of requirements constitute the functionality of the object system. In other words, the need for the object system is formally made explicit in terms of a set of system requirements. The analysis phase results in the **functional model** of the object system. The synthesis phase is called **devising specifications**. This phase constitutes the set of activities with the objective to specify the construction of the object system. The synthesis phase results in a complete specification of the construction of the object system, preferably starting with the ontological model. The phases are carried out iteratively, the iteration ends when an optimal balance is reached between (necessary) requirements and (feasible) specifications.

The design process is influenced by **architecture**. Conceptually, architecture is defined as the normative restriction of design freedom. It appears that design freedom of designers, particularly in the domain of enterprises and IT, is very large. Unfortunately this leads to undesirable system design. Operationally definition of architecture is a set of consistent (without contradiction) and coherent (common roots of origin) set of design principles. The principles have to be taken into account during the design process.

1.2 Thesis Description

The previous section reflects on the Ministry of Finance's need for a guide for business and IT integration. This implies the need for guidelines for deriving IT system specification from the (current) organization's construction and implementation. Nevertheless, such guidelines tend to be abstract. Within the above described context the Ministry of Finance needs a structured, concrete and well defined approach for defining and investigating its organization and IT system integration, in order to obtain the notion and awareness of business and IT integration. In addition, a well defined, comprehensive and standard notion of the organizational aspects, IT support and IT system should be introduced.

Intuitively, one would expect an approach or framework for the development of IT systems being based on organizational knowledge. Since the actual design and development of IT systems is being conducted by outsourced vendors, intensive participation of the Ministry during this process, is only required during the requirement elicitation process and the acceptance (by the Ministry) of the IT system. Participating in the requirements elicitation process requires sufficient knowledge or guidelines for defining functional requirements for IT systems. Accepting an IT system requires sufficient knowledge or guidelines for assessing the delivered system. The framework to be developed during this thesis project provides guidance for assessing existing IT systems. Note that the same knowledge is required for both the requirements elicitation and the acceptance (assessment) phase. This concerns the knowledge of business and IT integration and the notion of related aspects. However, IT awareness is currently not sufficiently present within the Ministry of Finance. This explains the need for an introduction of guidelines and notion of relevant aspects concerning business and IT integration.

In order to omit undesirable consequences of this 'technology push', it has been chosen to construct guidelines within the scope of an acquainted environment. The assessment of IT systems requires knowledge of the organization and the concerning IT system. The Ministry is acquainted with the current organization and existing IT system. It has been chosen to introduce guidelines within the Ministry, for assessing existing IT systems. The idea is to provide sufficient knowledge and awareness of IT integration. This is the justification for omitting the development of guidelines for defining functional requirements for new IT systems. Considering the above, the following is defined as the research goal:

Research Goal

DEVELOP A WELL-FOUNDED FRAMEWORK FOR ASSESSING IT SYSTEMS BY THE SURINAME MINISTRY OF FINANCE

The Generics System Development Process (described in section 1.1.2) provides a complete picture and sound definition of organization as well as IT system aspect models and their relation. Therefore, it has been decided to build the expected framework on the structure and the notion of different aspects provided by the Generic System Development Process.

1.2.1 Research Approach

The thesis project was conducted in three phases:

1. Analysis of the current organization of the Directorate of Finance This phase was completely conducted at the Suriname Directorate of Finance. The result was an overview of the current organization constituted in formal models as defined in the GSDP.
2. Development of the assessment framework This phase was conducted at the Delft University of Technology. First a delineation process for the GSDP was executed, for identifying the relevant aspects required for the assessment framework. In addition, the specific notion of the chosen aspects is defined for the Ministry of Finance. The result is a structure of relevant aspect models and corresponding tables, which provide the representation of these models.
3. Application of the assessment framework for the Directorate of Finance This phase was conducted at the Delft University of Technology. The developed framework was applied to the Suriname Directorate of Finance. The result was the complete production of every aspect model of the assessment framework for the Directorate of Finance. Unfortunately, for organizational reasons, the application of the framework was not performed in collaboration with (employees of) the Directorate of Finance. The results of this phase are not included in this report, rather they can be found in the accompanying addendum.

1.2.2 Constraints and Boundaries

1. The Generic System Development Process is the scientific base for the construction of the assessment framework. Therefore, the notion and theoretical base of relevant aspects are adopted from this scientific approach
2. The design process of IT systems will not be elaborated on, since the focus is on the assessment of aspect models of IT systems
3. The framework will be constructed in such a way that business and IT integration is introduced in a practical and convenient way

4. The framework will be constructed in such a way that the Ministry is aided in approaching business and IT integration from a higher level of abstraction (restrain from detail)
5. The assessment of IT systems will be on the functional (black box) level of abstraction
6. Non-functional factors of the IT systems are not taken into account
7. The framework does not describe which models are used for providing information of the IT system. The reason for this is, because this information is provided by the vendor
8. It is assumed that the software vendors uses appropriate techniques and models and provide correct information about the IT systems design
9. Existing standard methodologies, for implementing GSDP aspects are used (e.g. DEMO)

1.3 Research Value

1.3.1 Added Value for the Suriname Department of Finance

The use of an assessment framework for IT systems provides the possibility for gaining sufficient knowledge in area of business and IT integration. This may improve IT decision making, especially in defining functional requirements for future IT systems. In addition, such a framework requires a thorough evaluation of the organization, which may light up possible inefficiencies, redundancies, inconsistencies and incompleteness's within the Ministry's organization. If the framework is defined in such a way, that it is understandable for the employee's, it may stimulate participation during IT projects.

1.3.2 Scientific Relevance

The Generic System Development Process is a relatively new approach on the development of systems. Even though every aspect is well defined and structured, standard methodologies for implementing all of these aspects do not exist. Of course, the focus of this thesis is the development process of information systems. The framework may provide a starting point for the construction of methodologies for some aspects and the relation between the 'new' methodologies and the existing ones. If, at one time, every aspect is not only well defined but also coincides with proven methodologies, the development process for information systems, becomes much more understandable and integrated for every related expert (e.g. domain experts and information engineers).

1.4 Reading Guide

In chapter 2 the GSDP is delineated for the construction of the assessment framework. In addition, the structure of the framework is presented. Chapter 3 focuses on the first conceptual model of the framework: the 'ontology of the organization'. The structure of this model and the methodology used for expressing this model are presented and explained. Chapter 4 addresses the 'implementation of the organization' as a conceptual model of the framework. The structure of this model and the tables used for expressing this model are presented and explained. Chapter 5 concerns the 'functional model of IT systems' as a conceptual model of the assessment framework. The structure of this model and the tables used for expressing this model are presented and explained. This model consists of tables containing information which should be used for the actual assessment of an IT system.

This report is accompanied with an addendum, which is the result of a practical application of the assessment framework at the Suriname Directorate of Finance. Each conceptual model is completely produced in this report. Concluding the existing IT systems are evaluated based on the information contained in the tables defined in the assessment framework. Appendix A contains applied diagrams and tables on the Ministry of Finance.

Chapter 2

Framework Structure

This chapter focuses on the structure of the assessment framework. The framework is based on the Generic System Development Process. First the theoretical description of relevant parts of the GSDP is provided along with the notion of model. Secondly the delineation of the GSDP is discussed. Concluding the framework aspects and their relation is presented.

2.1 Theoretical Background

Adopting the notion of using system and object system from the Generic System Development process, the organization coincides with the using system and the IT system coincides with the object system[1]. In addition, the following notion of model provided in [*Apostel*, 1960] is adopted: any system using a system A that is neither directly nor indirectly interacting with a system B, to obtain information about the system B, is using A as a model for B. This definition of model implies the possibility and minimal requirements for using (conceptual) models for analyzing and designing, and therefore assessing, (concrete) systems[2].

The objective of the assessment framework is to provide sufficient information of the Ministry's organization and existing IT systems for analyzing and therefore assessing IT support. Recall now the correspondence of the using system and object system, respectively with organization and IT systems. Since the organization and IT systems are both implemented systems, they are considered concrete systems. Provided the notion of model as described above, the need for conceptual models of the organization and existing IT systems of the Ministry is made visible. In addition, these conceptual models should correspond with some representation techniques, constituting the symbolic model[3].

2.2 Framework Delineation

As should be clear now, the objective of the framework is to provide enough information of the Ministry's organization and the existing IT systems in order to investigate the cor-

[1] Chapter 3 provides the notion of system and the explanation for why an organization is considered a system

[2] a distinction between conceptual, symbolic and concrete system is adopted from the model triangle explained in [*Dietz*, 2006]

[3] An example is the aspect models (conceptual model) and corresponding diagrams and tables (symbolic model) defined in DEMO [*Dietz*, 2006]

rectness and completeness of IT support. The first concern in determining the structure and aspect models of the assessment framework is defining an unambiguous notion of what is meant with IT support.

The traditional software (IT system) development process includes five activities: requirements elicitation, analysis, system design, object design and implementation [*Bruegge and Dutoit*, 2003]. These activities require participation of experts of different backgrounds. Domain experts intensively participate in the requirements elicitation and analysis phase. Domain experts are the employees of the organization using the IT system to be constructed. During requirements elicitation the functions and behavior of the IT system are defined in terms of functional requirements. In other words, the question; *'what information services should the IT system provide to the organization (users)?'*, is answered. Recall the relation of using system and object system defined in the GSDP. The using system uses the object system, otherwise put, the object system supports the using system. Therefore, IT support is as the provision of information services by IT systems to an organization. The assessment of IT systems therefore includes the investigation of the correctness, consistency and completeness of the set of information services it provides to the using organization. Note here that within the scope of this research, IT support only concerns the functionality of the IT systems, the non-functional factors of the IT systems are omitted.

IT support

The next concern in defining the structure and aspect models of the assessment model is the perspective with which these systems (organization and IT systems) should be viewed, in order to provide a sufficient assessment of IT support. The theoretical foundation of the GSDP distinguishes between the functional and the constructional perspective on systems. The functional perspective means 'looking at it' from the using system's point of view [*Dietz*, 2006]. This means that the functional model of a system includes the description of the external behavior of that system, thus the transactional (or interface) relation with the environment. Analogous, the constructional model defines the construction and operation of a system [*Dietz*, 2006]. In other words, the internal elements of a system and their relations are revealed in its construction model.

As discussed above, the assessment of an IT system is based on the information services it provides to the organization. Recalling the definition of the function perspective, it can be concluded that the functional model will provide sufficient information for the assessment of IT systems. For the same reason domain experts should participate in the requirements elicitation process, there should be sufficient domain knowledge for the assessment of IT systems. Actually, the assessment of an IT system has a structural analogy with the requirements elicitation process, it is 'the other way around'. Recalling the definition of construction perspective, it can be concluded that the information provided by the constructional model most coincides with the required knowledge of the organization for the requirements elicitation process and therefore the assessment process. Figure 2.1 constitutes the delineation of the Generic System Development process for the structure of the assessment framework.

2.3 Framework Aspects

In the previous section, the constructional model of the organization and the functional model of IT systems are delineated for the assessment framework. Figure 2.2 provides the structure and the aspects of the framework. The 'Organization As Is' constitutes the constructional model of the Ministry's organization. Note the correspondence with the using system of the GSDP. The 'Organization As Is' consists of four conceptual models: organizational systems, business processes, actor role assignment, and information distribution. These models are defined on either or both the ontological and implementation level, in conformity with the GSDP. All conceptual models (on ontological or implementation level) are represented in appropriate diagrams and/or tables. The representation tables of the implementation models are specifically defined for the assessment framework. Chapter 3 and 4 respectively elaborate on the ontological and implementation

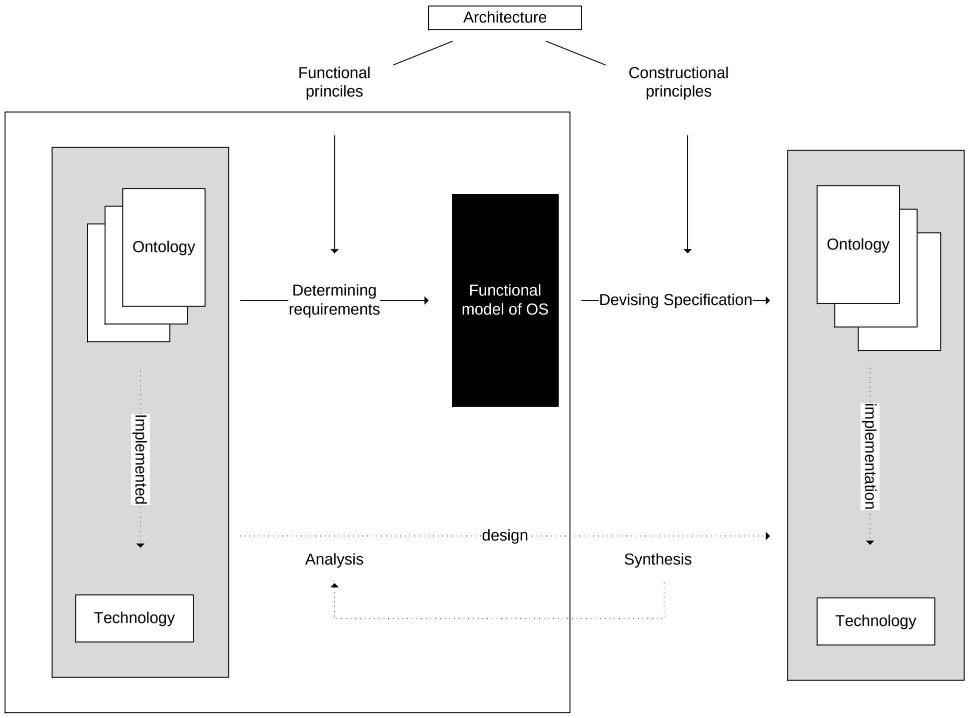

Figure 2.1

delineated Generic System Development Process

models of the organization. As described in the previous section, these models are constructional (white box) models.

The 'Existing IT system' constitutes the functional model for any of the existing IT systems of the Ministry's organization. This model corresponds with the functional model of the object system of the GSDP. The 'Existing IT system' consists of three conceptual models: identification of functions, functional decomposition and user distribution. All conceptual models are represented in appropriate tables. In addition, consistency tables are defined for the assessment of the concerning IT system. The representation and consistency tables are specifically defined for the assessment framework. The functional model of IT of systems is based on knowledge constituted in the 'Organization As IS' and (design) information about the IT systems provided by the developing vendor. Chapter 5 elaborates on the functional model of IT systems.

2.3.1 Implementation of Framework

The framework is implemented after the production of the diagrams and tables. The 'Organization As Is', is the first model to be implemented. It is recommended to start with the ontological model of the organization since, as will become clear further in this report, it provides the construction of the complete organization independent from its implementation. The order in which the three ontological models should be produced is described in section 3.5. The implementation models are the next to be produced. This is, really, the implementation of the ontological model conform the GSDP. The order in which the two implementation models should be produced is described in section 4.4. The functional model is implemented after sufficient information has been provided by the vendor. It is much more effective to implement the functional model, during the design phase of IT systems. In this way, correctness issues are clear before the actual implementation of the IT systems. However, as was explained in section 1.2 the devel-

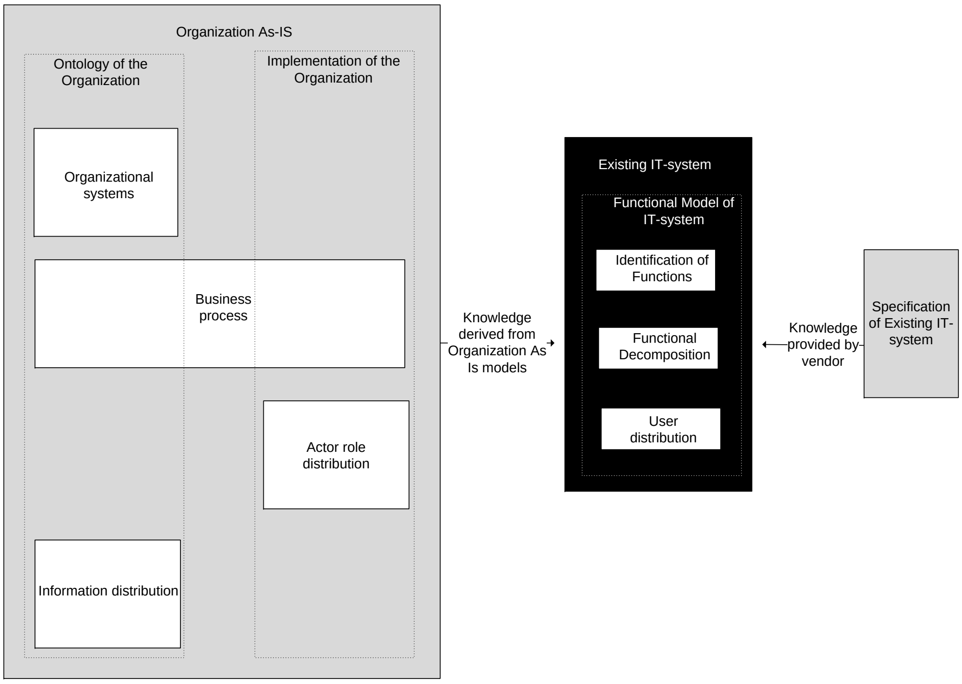

Figure 2.2

Assessment Framework Structure

opment of guidelines for defining IT system's functionality was explicitly omitted. The order in which the functional models should be implemented is described in section 5.5.

Chapter
3

Ontology of the Organization

This chapter discusses the ontological model of an organization. The 'ontology of the organization' as a conceptual model of the assessment framework is presented and described. First the theoratical notion and definition of relevant aspects is provided. In addition,the different ontological aspect models of the 'Organization As-Is' and the corresponding diagrams and tables are described. Concluding the order in which the diagrams and tables should be produced is discussed.

3.1 Theoretical Background

Systems belong to a specific category since system elements are not able to participate in every structural relation. The category of a system is determined by the kind of relations in which system elements are able to act. Organizations consist of human beings socially interacting in order to produce things. For modeling the organization, it is required to know which properties it inherits. A system defined as follows:

System

Something is a system iff[1] it has the following properties:

- Composition: a set of elements of some category
- Environment: a set of elements of the same category; the composition and the environment are disjoint
- Structure : a set of influence relations among the elements in the composition and between them and the elements in the environment
- Production: that what is produced by the elements of the composition, once they are activated through their structural links.

System Construction

The construction of a system consists of the structure of the system, the composition and the environment. The construction $<C(\sigma),E(\sigma),S(\sigma)>$ of a system σ belonging to category Γ is formally defined by:

- The composition C of σ is defined as:
  $C(\sigma) = \{x \in \Gamma \mid x \prec \sigma\}$
- The environment E of σ is defined as:
  $E(\sigma) = \{x \in \Gamma \mid x \notin C(\sigma) \wedge \exists y\text{: } y \in C(\sigma) \wedge (x \triangleright y \vee y \triangleright x) \}$
- The Structure S of σ is defined as:
  $S(\sigma) = \{ <x,y> \mid (x \triangleright y \vee y \triangleright x) \wedge (x,y \in C(\sigma) \vee (x \in C(\sigma) \wedge y \in E(\sigma)))\}$,

[1] iff is an abbreviation if and only if

Where
$\prec$ - denotes a 'part of' binary relation, and
$\triangleright$ - denotes a 'acts upon' binary relation; x $\triangleright$ y iff influences the behavior of y
if both x $\triangleright$ y and y $\triangleright$ x hold then it is said that x and y interact.

As explained in the previous chapter, the ontological model of a system is the conceptualization of a system from a construction perspective. Thus the methodology for constructing the ontological model of a system should at least adopt the above described formal definition of system composition, environment and structure. DEMO (Design and Engineering Methodology for Organizations) will be used as the representation of the Ontology of the Organization as defined in the assessment framework. DEMO is based on the ψ theorem, which consists of four axioms and one theorem; the operation axiom, the transaction axiom, the composition axiom, the distinction axiom and the organization theorem. The complete description of the theoretical background of DEMO and the methodology itself can be found in [*Dietz*, 2006]. When relevant, parts of the axioms and the organization theorem are referred to in the course of this report.

In the ψ theorem, the composition of an organization is the set of internal actor roles. The environment is the set of the external actor roles. The structure of an organization consists of the social interactions among internal actor roles and between internal and external (environment) actor roles. An example of a production of an organization is the service it delivers.

Organization

The organization theorem states that an organization is a heterogeneous system that is constituted as the layered integration of three homogenous systems: the B-organization, I-organization and D-organization [*Dietz*, 2006]. The B-organization is supported by the I-organization, which on its turn is supported by the D-organization. The ontological model of an organization only constitutes the B-organization. The relation with and the construction of the I-organization and D-organization is constituted in the implementation model of the organization (see also chapter 4).

The ontology of the organization as an aspect model of the assessment framework constitutes the constructional model of the B-organization of the organization. The structure of the ontology of the organization is exhibited in figure3.1. The ontology of the organization consists of four integrated conceptual models: organizational systems, business process and information distribution. These models as an integrated whole express exactly the same as the integrated set of ontological aspect models defined in the DEMO methodology([*Dietz*, 2006]). Sections 3.2, 3.3 and 3.4 elaborate on these conceptual models.

3.1.1 Government Subsystem

Intuitively one would think that the complete Ministry of Finance would constitute an organizational system. However the Ministry of Finance is one part of the set of integrated governmental departments. Most governmental processes are not completely executed within one ministry. The government financial process is an example of a process that is carried out at every ministry, where the Ministry of Finance holds the most responsibilities. Any of these processes require actors holding a set of influence relations. Thus the complete government organization itself may be addressed as an organizational system. This means that the composition of the complete government consists of departments within the ministries or in more detail the employees of these departments, Ministers and the President. The environment consists of citizens and private companies requesting government services, delivering institutions (e.g. delivering companies, non-governmental organizations) delivering services to the government and the Suriname National Assembly auditing the government. In some cases, the President and Ministers are also considered environmental elements, because they represent the government, but they hold a political responsibility (as opposed to operational responsibility). The structure of the complete government consists of influence relations among the departments and between them and the governmental environmental institutions.

Provided this picture of the government's organization and the definition of system as provided in the GSDP, the following definition of government organization is inferred: An organization is an government organization iff

government organization

- the internal actor roles (elements of the organization's composition) are only fulfilled by governmental departments, ministers or the President
- the structure of the organization only consists of social interactions concerning government processes

Note that the government departments, ministers and the President are not ontological actor roles. Rather, the are the subjects fulfilling the actor role. However, in the identification of actor roles for the government organization, one can intuitively know whether the actor role will be fulfilled by other subjects than mentioned above. Ofcourse exceptional cases will occur, but some starting point and boundaries should be provided.

Now consider the following notion of subsystem as an extension of the notion of system from [*Dietz*, 2006]: The notion of a subsystem is formally defined as follows:
Let:

- σ_1 be a system with construction $<C(\sigma_1),E(\sigma_1),S(\sigma_1)>$, and
- σ_2 be a system with construction $<C(\sigma_2),E(\sigma_2),S(\sigma_2)>$

then system σ_2 is a subsystem of system σ_1 iff:

- $C(\sigma_2) \subset C(\sigma_1)$, and
- $E(\sigma_2) \subset ((C(\sigma_1) \setminus C(\sigma_2)) \cup E(\sigma_1)))$, and
- $S(\sigma_2) \subset S(\sigma_1)$

government subsystem

This concludes in the following definition of government subsystem : An organization is a government subsystem iff:

- the composition of the organization is a subset of the composition of the government organization
- the environment of the organization is a subset of the environment of the government organization and/or a subset of the remaing elements of the composition of the government organization
- the structure of the organization is a subset of the structure of the government organization
- an influence relation between government subsystems is not necessary, with the condition that there should be at least one informational relation (sharing information) with another subsystem and one influence relation with external institutions

3.2 Organizational system

The construction and production of a government subsystem, as defined above, are constituted in the organizational system model. This conceptual model coincides with the DEMO interaction model, which shows the active influencing relationships between actor roles, through their being initiator or executor of transaction types. Since all the organization (addressed as a system) properties are modeled in this model, the intuitive name for this model was just organization. Nevertheless this not complete for two reasons; this model is also suitable for subsystems and addressed from a system perspective an organization is a system. Traditionally organizations are not addressed from a systems perspective. The Ministry of Finance is acquainted with the traditional view on organizations. In addition, the notion of system, specifically the one adopted for the development of the assessment framework, has not been introduced. In order to build the framework, within an acquainted environment, it has been chosen to use the term organizational system. From the traditional view organizational system says; 'organization viewed as a system'. The DEMO interaction model is expressed in the Action Transaction Diagram and Transaction Result Table.

3.2.1 DEMO Action Transaction Diagram

The DEMO Action Transaction Diagram constitutes the construction of an organization. It defines a boundary rectangle for separating composition and environmental elements of the concerning organization. Elementary actor roles are always drawn within the boundary rectangle and constitute the elements of the composition. Composite actor roles drawn inside the boundary rectangle coincide with subsystems of the concerning system. Composite actor roles drawn outside the boundary rectangle coincide with elements of the environment of the concerning organization. Transactions constitute the influence relations between actor roles coinciding with the structure of the concerning organization. In addition, the initiating and executing actor of the transactions are depicted through an initiator and executor link. A detailed description of the legend of the ATD can be found in [*Dietz*, 2006].

The ATD should be constructed after the identification of the government subsystem conform the definition of government subsystem provided in section 3.1.1. An example of such a subsystem is the budget cycle organization. The Directorate of Finance is the branch of the Ministry of Finance that focuses on every aspect regarding government expenditures, which are based on the annual operational government budget. The complete process from the determination of the budget to the accounting and auditing of the government expenditures, lies within the responsibility of the Directorate of Finance. This process is called the budget cycle. However, other ministries also play an essential role in the execution of the budget cycle. The collection of the departments executing the budget cycle, the concerned external institutions (e.g. the Suriname National Assembly) and the influence relations among these departments and between them and the external institution may be considered to be the construction of, what is identified as the budget cycle organization.

3.2.2 DEMO Transaction Result Table

The DEMO Transaction Result Table (TRT) constitutes the production of the organization for every transaction (influence relation). The operation axiom of the ψ theorem states [*Dietz*, 2006]that the operation of an enterprise is constituted by the activities of actor roles. In doing so two kinds of acts are performed: production acts and coordination acts. By performing coordination acts subjects enter into or comply with commitments towards each other regarding the performance of production acts. By performing production acts, the subjects contribute to bringing about the goods and or services that are delivered to the environment of the enterprise. These goods and services coincide with the production of the organization. The transaction axiom of the ψ theorem states [*Dietz*, 2006] that coordination acts are performed as steps in universal patterns, called transactions. Combining these axioms, it can be concluded that transactions result in the production (or so called P-facts) of the organization. The TRT provides an oversight of the organization's transaction and resulting production facts. As an example the TRT of the budget cycle organization is depicted in table A.1.

3.3 Business Processes

As described above, a transaction is a universal pattern in which coordination acts are performed. The composition axiom of the ψ theorem states [*Dietz*, 2006] that every transaction is either embedded in some other transaction, or it is a customer transaction, or it is a self activation transaction. From [*Dietz*, 2006] the following definition of business process is adopted: a structure of causally interconnected transactions, such that the starting step is either started by an actor role in the environment (customer transaction) or a request by an internal actor role to itself (self activation). Embedded transaction are causally related to either a starting (customer and self activation) transaction or to an embedded transaction. The business process model, as defined in the assessment framework, coincides with the DEMO process and action model. The process model shows the

business process

structure of the business processes and for each transaction the pattern in which coordination acts are performed. In addition, the responsible actor role for each coordination act is depicted. The action model specifies guidelines for each actor role for the execution of the coordination acts for which it is responsible.

3.3.1 DEMO Process Step Diagram

The DEMO Process Step Diagram (PSD) expresses the DEMO process model. Part of the knowledge for constructing the PSD is inferred from the ATD. The PSD details the identified transaction, by providing the allowed pattern in which coordination acts are performed. Thus, it shows the allowed coordination acts: coordination acts that are not allowed are not represented. The collection of transactions constituting a business process are derived from the ATD. The order in which the transactions in one of these collections are initiated and their causal relations is determined in the PSD. Thus a PSD is constructed for each identified business process. The PSD exhibits process steps, each coinciding with the coordination acts and corresponding fact. In addition, causal and conditional links are defined. Cardinalities are defined for each causal or conditional link. The default cardinality is 1..1. In addition, a representation for external activation (for customer transactions) and self activation is provided. An actor role is responsible for a set of coordination acts. In the PSD responsibility areas coincide with an actor role and is represented with a rectangle. The coordination acts for which a certain actor role is responsible, is ’bundled’ within the boundaries of the responsibility area.

Recall the ATD of the budget cycle organization. Seven business processes can be identified. The complete set of business processes is the set of the following collections of transactions constituting exactly one (1) business process: (T01, T02, T03), (T04, T05), (T09), (T08, T10), (T13, T11), (T12) and (T19, T20, T21). The latter collection (T19, T20, T21) constitutes the salary process, which is depicted (in a PSD) in figure A.2.

3.3.2 DEMO Action Rules

The causal and conditional relations defined in the process step diagram are described in detail in the action rules. For each process step, the causal successor is determined. Ofcourse this information is also represented in the process step diagram. The added value of the action rules is particular for the process steps with more than one successor or the causal links with cardinality greater than one.

Until now, the models of DEMO-2 were used. The DEMO-2 action rules are listed for each actor role per process step. Consequently, process steps of different business processes are addressed in the same ’list’. This of course, only holds for composite actor roles, since elementary actor role can only take part in exactly one business process. In the DEMO-3, for each business process, action rules per actor role per process step are given. This provides a better insight in the responsible actors per process.

The action rules are represented in an action rule table, consisting of four columns: actor, agendum, condition, action. In the actor column, the concerning actor role to which the defined action rules apply, is mentioned. The agendum column contains the process steps to which the included action rules apply at the time of occurrence. The condition column contains IF-ELSE and DO FOR ALL rules. The action column contains the successor process steps of the process step in the agendum column. Table A.2 provides a concrete example of an action rule table for the salary process.

3.4 Information Distribution

As described above, the other two ontological aspect models of the assessment framework, coincide with the DEMO interaction model, process model and action model. The last DEMO aspect model is the state model. The ’Information DIstribution’ model as an ontological aspect model of the assessment framework, is identical to the DEMO state model. The term ’information distribution’ is choosen for practical reasons. According to

[*Dietz*, 2006], the state model consists of specifying object classes, factum types, statum types and the existensial laws that hold. First the notion of these aspects is presented. The DEMO-3 the state model is expressed in a Fact Result Diagram (FRD). The corresponding cross reference tables are the Information Use table (IUT) and Object Property List (OPL). The OPL lists the properties of the identified object classes and fact types. As stated above, the framework should be created in a such a way that the Ministry is aided in approaching business and IT integration on high level of abstraction. The OPL, eventough expressing a small part of the ontological model of the organization, presents detail information of the object classes and fact types. This may lead to confusion in the production of the OPL. For this reason the OPL is not used in the assessment framework. The 'information distribution' model is thus expressed in the DEMO Fact Result Diagram and Information Use Table.

A distinction is made between two kinds of objects: stata and facta [*Dietz*, 2006]. A statum is something that is just the case and that it will always be the case. In the budget cycle organization an example of a statum type is " Budget B is operational for Year Y". A factum is a result or the effect of an act. An example of a factum type is "'Budget B has been operationalized". Recall the P-facts reflected in the DEMO-TRT; the P-facts are factum types. Object classes reflect the domain of the stata or facta. The existence laws determine the inclusion or exlusion of the coexistence of stata. The inclusion laws are the reference law and the dependency law. The exlusion laws are the unicity law and exclusion laws. The complete description of stata, facta and existence laws is discussed in [*Dietz*, 2006].

3.4.1 DEMO Fact Result Diagram

The DEMO Fact Result Diagram (FRD) is based on the World Ontology Specification Language (WOSL) described in [*Dietz*, 2006]. Statum types are notated in a rectangle box. Object classes are noted in so called soft box. The relation between the statum types and object classes are constituted in the coexistence inclusions laws. These laws have their own seperate notation. The factum types are notated by a diamond encapsulated in a soft box.

The FRD is constructed after the production of the 'Organizational System' model and the 'Business Process' model. The object classes and fact types depicted in the FRD are inferred from the action model.The FRD is constructed for the complete organization. Figure A.3 depicts the FRD for the budget cycle organization. The internal object Note the correspondence of the factum types depicted in the FRD and the P-facts listed in the TRT.

3.4.2 DEMO Information Use Table

The DEMO Information Use Table (IUT) specifies for every object class and fact type in which process step it is used. The information provided in the IUT is inferred from the FRD and the action model. Note that this table integrates the information of the PSD and FRD. The DEMO IUT originally consists of two columns: 'object class or fact type' and 'process step'. The latter column lists the process steps which use the object class and fact type. In [*Albani et al.*, 2005] a business component identification matrix is introduced, where the rows constitutes the process steps and the columns consitute the object classes or fact types. The enries are marked 'U' or 'C' respectively denoting that the object classes or fact types use, created are used in the corresponding process step. In addition a algorithm is provided, which rearranges the row and columns in such a way that groups of relationships can be recognized. These groups then identify business components. The idea is to group all 'create' entrie into a business components and as few as possible 'use' entries outside business components. The dependencies between the business components are defined by the 'use' entries. The identified business component provide a basis identifying subsystems during the design of IT systems. Since the objective of the assessment framework is to analyse and assess IT systems, the idea of assigning 'creates' and 'uses' is adopted from [*Albani et al.*, 2005]. The IUT is therefore adapted in such a way, that an extra column is introduced. The adapted IUT now consists of three columns: 'object class or factype', 'create' and 'use'. The 'create' and 'use' columns consists of process steps in which the object classes or fact types are respectively created are used. Table A.3 depicts the IUT of the budget cycle organization.

3.5 Producing the Ontogical Model

The ontology of the organization as defined in the assessment framework is constructed after the production of all of the specified ontological aspect models; 'organizational systems', 'business process' and 'information distrbution'. The government subsystem under investigation should be identified in precedenc of the production of the DEMO ATD and TRT. This results in the 'organizational system' model. Next the 'business process' model is produced. First business processes are identified, succeeded by the construction of a DEMO PSD for each of the identified business processes. The 'business process' model is completed with the construction of a DEMO action rule table for each business process. Concluding the 'information distribution' model should be produced. First the DEMO FRD is constructed succeeded by the construction of the adapted DEMO IUT. Note that the sequence of producing the DEMO diagrams and tables is adopted from the proposed sequence of construction in [*Dietz*, 2006]. Therefore one is referred to [*Dietz*, 2006] for the argumentation behind this sequence.

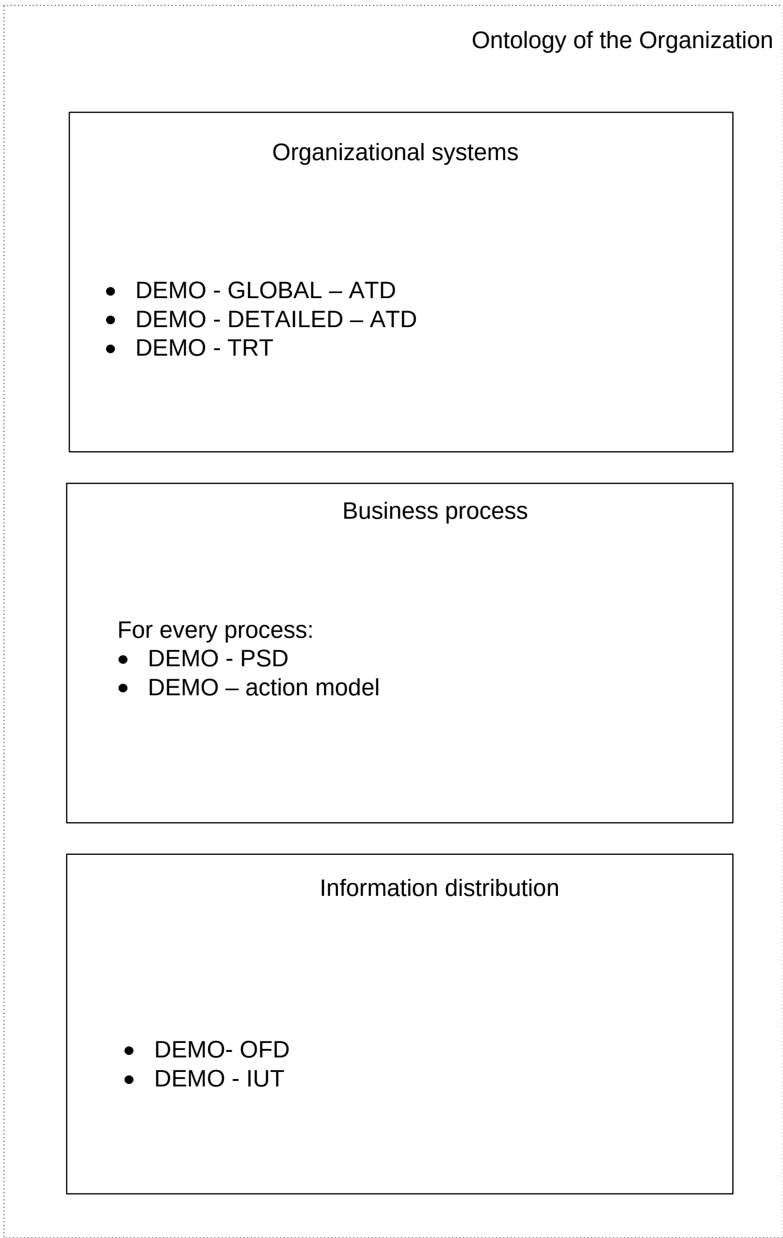

Figure 3.1

Ontology of the Organization

Chapter 4

Implementation of the Organization

This chapter discusses the implementation model of an organization. The 'implementation of the organization' as a conceptual model of the assessment framework is presented and described. First the theoretical notion and definition of relevant aspects is provided. In addition, the different implementation aspect models of the 'Organization As-Is' and the corresponding tables are described. Concluding the order in which the tables should be produced is discussed.

4.1 Theoretical Background

Recall the definition of organization as defined in the organization theorem: an organization is a heterogeneous system that is constituted in the layered integration of three homogeneous systems: the B-organization, I-organization and D-organization. The ontological model only constitutes the B-organization. The 'Organization As-Is', coincides with the using system of the GSDP. The ontology of the organization, as a conceptual model of the 'Organization As-Is' is discussed in chapter 3. This chapter focuses on the implementation model, conform the definition in the GSDP, of the organization.

As described in section 2.3 the conceptual models of the 'Organization As Is' are defined on either or both the ontological and implementation level. The GSDP defines the implementation model as the model that can directly be implemented, such that it can become operational. The organization theorem (of the ψ theorem) distinguishes between two ways of making the organization of an enterprise operational; realization and implementation. By the realization of an organization is understood the thorough integration of the three aspect organizations. This integration is defined as the D-organization supporting the I-integration, which on its turn supports the B-organization. The other way around, the B-organization uses the I-organization, which uses the D-organization. Recall the distinction between function and construction perspective. It is applied in the organization theorem in such a way that the construction of one organization that is supported by the function of the other. For example the construction of the B-organization is supported by the function of the I-organization. Note that, in the assessment framework, the construction of the B-organization is presented as described in chapter 3. In order to obtain the complete implementation model of an organization, at least the function and construction of the I-organization and the function of the D-organization are required. Note also that it was argued in section 2.2 that the implementation model of the 'Organization As-Is' should be depicted in a construction model.

By the implementation of an organization is understood the making operational of the realization of an organization by means of technology. An example is the fulfilling of an actor role by a subject. The basic elements of the construction of an organization are the actor roles and the transactions. Thus, obtaining the complete implementation of the organization requires the implementation of the actor roles and the transactions. In addition, business processes are defined as collections of transactions with causal interconnections. Therefore the implementation model as an aspect model of the assessment framework, is constituted in a business process model and an actor role distribution model. Figure 4.1 depicts the structure of the implementation model. Note here, that the authority hierarchy and the actor role assignment as described below only address departments. The functional hierarchy of the departments is not addressed. Of course, in the course of time, this will appear necessary. However, it has been chosen to build the assessment framework on this level of detail.

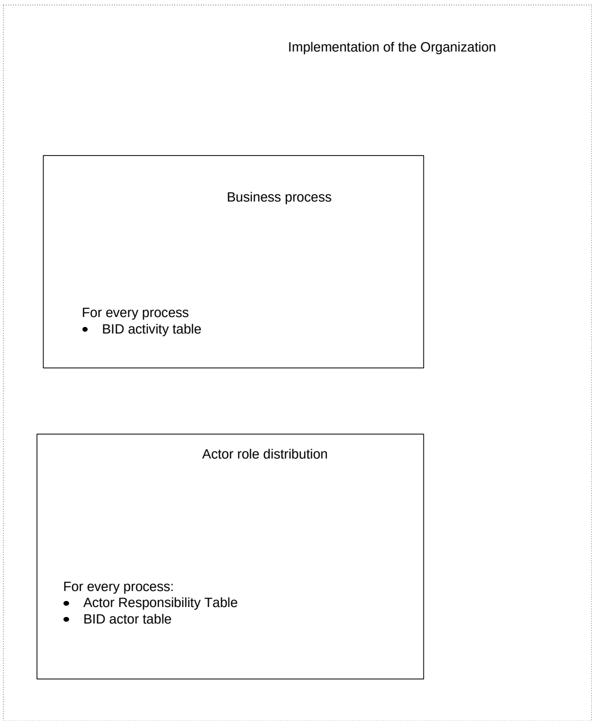

Figure 4.1

Implementation of the Organization

4.2 Business Processes

Recall the ontological model of the business process model described in section 3.3. This model depicts the structure of causal and conditional relations among transactions (business processes) and the pattern of so called process steps. The implementation model contains the support provided by the I-organization and D-organization to the transactions defined in the ontological model. The distinction axiom of the ψ-theorem states [*Dietz*, 2006] that there exist three distinct human abilities playing a role in the operation of actors, called performa, informa and forma. These abilities regard communication, creating things, reasoning as well as information processing. The forma ability concerns the form aspects of communication and information. For example saving student information on paper in a file case or electronically saving the same information on a computer hard disk. The informa ability concerns the content aspect of communication and information. Examples of informa 'things' are human thoughts, knowledge of a subject and the ability to reason. The performa ability concerns the bringing about of new things, directly or indirectly by communication. Examples of performa 'things' are commitments, decisions and judgments. The performa, informa and forma ability of an actor respectively coincides with the required competencies for operating in the B-organization, I-organization and D-organization.

As said before, actor roles are responsible for the execution of transactions and therefore the process steps. From the distinction in actor abilities, it can be concluded that there exist activities in the B-,I- and D- organization, which will require respectively the performa and informa and forma ability for proper execution. This also takes the definition of realization of an organization into account, where thorough integration of the aspect organizations is defined as the support of the construction of one organization by the function of the other. Even though the B-,I- and D- activities are not the function of the corresponding organizations, the function can easily be inferred from the activities. The business process model at the implementation level, depicts the B-, I- and D-activities for each process step defined in the ontological model. Note here that the B-activities are already defined in the process step diagram and the action rule table.

4.2.1 BID-activity Table

The BID-activity table is the symbolic model of the business process model on the implementation level. It is specifically defined for the assessment framework. Part of the knowledge for the implementation of this table is inferred from the process step diagram and the action rule table. The BID-activity table is constructed for every identified business process. Thus the complete business process model (ontological and implementation) consists of a process step diagram, action rule table and BID-activity table for each identified process.

The BID-activity table consists of four columns; process step, B-act, I-act and D-act. The process step column contains the process steps of the concerning business process. The B-,I- and D-act columns respectively the B-, I- and D-act for each process step. Recall now the definition of government organization and government subsystem. Some external actor roles of the government subsystem are internal actor roles of the government organization. The remaining external actor roles of the government subsystem are also external actor roles of the government organization. The behavior of the latter set of external actor roles is basically not known. For this reason, the process steps carried out by these actor roles are not depicted in the BID-activity table. The responsibility areas in the process step diagram depict process steps for which the actor roles are responsible.

Table A.5 depicts the BID-activity table for the salary process. Note the correspondence between the process steps defined in the PSD and the B-act column of the BID-activity table. The I-activities relate to the production, processing, checking, provision and confirmation of information. The D-activities relate to documentation of information and presentation and reading of these documents.

4.3 Actor Role Distribution

In order to abstract from a particular subject (person) that performs an action, the notion of an actor role is introduced in DEMO [*Dietz*, 2003]. An (elementary) actor role is defined as the institutional authority that is necessary and sufficient to be executor in a particular transaction [*Dietz*, 2006]. The competencies of the actor role, in terms of know-how and knowledge, are the ground to grant authority. The social need to perform in an accountable way is a social result of a granted authority. An actor role can be fulfilled by a number of subjects (concurrently, consecutively as well as collectively), and a subject may fulfill a number of actor roles. In [*Dietz*, 2003] a distinction is made between three kinds of role assignment; authorization, delegation and propagation. The assignment of authority, authorization, is granted as described above. This means that an actor role fulfills the executing role of some transaction and the initiating role of all its embedded transactions. According to [*Dietz*, 2003] any transfer of authorization by the (primary or institutional) executor of a transaction to someone else, is called delegation. The delegated subject only executes a part of a complete transaction, since the primary executor performs at least the promise act. In addition [*Dietz*, 2003] provides a general rule; the subject that plays the initiator role of a transaction is also allowed to play the executor role in the acceptance act of every embedded transaction. The taking over of this acceptance act is called propagation. In the case of delegation the delegate has to be aware of the transaction propositions and should adopt the delegator's norms and values concerning the transactions. In the case of propagation the propagate only has to be aware of the transaction propositions.

Generally, for every ministry it holds that the Minister has the responsibility of an accountable execution of the business process within his departments. Nevertheless, the competencies for the actual execution of these processes, lie outside the scope of his profession or even knowledge. The departments within the ministries are granted the authority to carry out government business processes or parts of these processes. The departments are considered to consist of employees with the competencies to carry out these processes. The responsibilities of business processes are considered to be delegated to the different departments by the Minister; they are politically delegated to execute government transactions. For this reason it is considered that the departments have the institutional responsibility and authority, whereas the minister has the political responsibility for an accountable execution of the business processes. However, scenarios exist where one or more actions are delegated to other or sub departments of the authorized departments or where accept acts are propagated. In addition, scenarios exist where some actions may only be carried out by a constitutional authority, for example a law may only be declared operational by the President. This requires a structure of possible authorities, which will be referred to as the authority hierarchy.

Authority Hierarchy

So far above four types of responsibilities have been identified within the Ministry of Finance; constitutional, political, institutional and delegated or propagated responsibility. It is not possible to delegate a constitutional authority. Political authorization always holds, the minister is politically accountable for every activity executed within his department. In addition constitutional authorization and political authorization are mutual exclusive. Political delegation is defined by the delegation or propagation of political responsibility to departments. Institutional authorization is thus the result of political delegation. Note that political delegation does not undo the political accountability of the delegator. Institutional delegation is defined by the delegation or propagation of institutional responsibility. Recall the distinction axiom, where the three distinct human abilities, performa, informa and forma are defined. Note that the authorities as described above, are granted for transaction defined for the B-organization, they will further be referred to as B-authorities. The subjects granted a B-authority will be referred to a B-actors. The B, I and D-activities, as defined in the BID-activity table, may not be executed by the same subject. However, the B-actor is still accountable for a proper execution of the I- and D- activities. Nevertheless, the subject executing I- and D-activities should have been granted some authority. For this reason operational authorization is defined as the authority assigned for the execution for I- and/or D-activities. This means that the subject operationally authorized, is responsible for a proper execution for the I- and/or D-activities. The B-actor is then said to operationally delegate its responsibility. Operational delegation is therefore defined as the transfer of responsibility for executing I- and D- activities.

Note that operational delegation does not exactly corresponds to the definition of delegation provided in [*Dietz*, 2003]; however this term is used for practical reasons. The next concern is to define rules that should be applied when using the authority hierarchy.

Two type of rules are defined; authorization rules and delegation rules

Authorization rules:

- In every case where no constitutional authority is granted, political authority is granted
- Constitutional authority and political authority are mutual exclusive
- Constitutional authority may only be granted to the President or Ministers
- Political authority may only be granted to Ministers
- Institutional authority is always a case of political delegation
- Operational authority always correspond with a B-authority which is accountable for the execution of the concerning activities

Delegation rules:

- Delegation, regardless of the kind, me only be provided to authorities on a lower level of the authority hierarchy
- Constitutional authorities are not allowed to provide delegations
- Political delegation is provided to departments within the ministry of the corresponding Minister carrying the political authority
- Institutional delegation is provided to any other government department. In the case of propagation it may be given to environment subjects
- Institutional delegated subjects are not allowed to grant delegations themselves

The actor role assignment model depicts the assignment of authorities of government departments to defined actor roles. The means of representation for this conceptual model are the actor responsibility table and the BID-actor table. These tables are specifically defined for the assessment framework.

4.3.1 Actor Responsibility Table

The Actor Responsibility Table depicts authorization for each process step of the B-organization. Part of the knowledge of the actor responsibility table is inferred from the PSD. The responsibility areas in the PSD determine the responsible actor role for each process step. The actor responsibility table is separately constructed for each business process.

The Actor Responsibility Table consists of five columns; process step, role, delegated/propagated, institutional and political. The process step column contains the process steps of the concerning business process. The role column contains the responsible actor role of each process step. The knowledge provided in these columns is inferred from the PSD. The remaining columns respectively show delegation (short for institutional delegation), institutional authorization and political or constitutional authorization. The political and constitutional authorization are depicted in the same column, since they are both on the highest level of the authority hierarchy and they are mutual exclusive.

Table A.4 depicts the Actor Responsibility Table for the salary process. Note here that the 'external' process steps are not left out, as was the case in the BID-activity table.

4.3.2 BID-actor table

The BID-actor table shows the executing subject of the BID-activities. The structure of the BID-actor table is analogous to the BID-activities table. The process step column is identical, even the entries. The remaining columns are B-actor, I-actor and D-actor. The knowledge for implementing the BID-actor table is partly inferred from the BID-activity table and the actor responsibility table. Note that for a specific process step the B-activity of the BID-activity table, coincides with the B-actor of the BID-actor table. The same holds for the I - and D- columns. The actor responsibility table exhibits the granted authorities for the B-activity. The lowest level of authorization or delegation contained in the actor responsibility table is repeated in the B-actor column. The I- and D-actors may be the same as the B-actor or may be subject to operational delegation.

4.4 Producing the Implementation model

The implementation of the organization as defined in the assessment framework is constructed after the construction of all of the specified implementation aspect models; 'business process' and 'actor role distribution'. The 'business process' model is implemented after the production of the BID-activity table for each identified business process. The order in which the BID-activity table and the actor responsibility table are constructed does not matter, since they are not related. However, it is advised to first produce the BID-activity table, resulting in the 'business process' model succeeded by the construction of the 'actor role' distribution model by successively producing the actor responsibility table and the BID-actor table. The BID-actor table may only be produced after the construction of these tables, since the knowledge for producing this table is inferred from the BID-activity table and the actor responsibility.

Chapter
5

Functional Model of IT systems

This chapter discusses the functional model of existing IT-systems. The functional model as a conceptual model of the assessment framework is presented and described. First the theoretical notion and definition of relevant aspects is provided. In addition, the different functional aspect models of the 'Functional Model of IT Systems' and the corresponding diagrams and tables are described. Concluding the order in which the tables should be produced is discussed.

5.1 Theoretical Background

In section 4.1 it was explained that the construction of an aspect organization, was supported by the function of the next lower layer organization. In [*Dietz*, 2006] the position of IT-systems within the layered integration of an organization is explained. Analogous to the distinction between the B-, I- and D-organization, a distinction between B-, I- and D- applications is made. The function of an application supports the construction of the corresponding organization. In section 2.2 the notion of IT-support was inferred. IT-support is considered to be the electronic provision of functions by IT-systems to an organization. Note the correspondence between these definitions of support. In section 2.2 it is stated that the assessment of an IT-system requires information of the supported organization and the IT-system. During requirements elicitation information of the organization is inferred in order to obtain the functional design of the IT system. Note that the information of the IT system is obtained from its design models. Chapters 3 and 4 provide representation models, which provide information of the organization. The concern is now to obtain representation models, which will provide information of the IT-system. The focus of the assessment framework, is obtaining information for assessing IT-systems. The requirement elicitation process, as positioned in the traditional software development process, is used as the basis for the identification of required representation models for assessing IT-systems.

According to [*Bruegge and Dutoit*, 2003], requirements engineering aims at determining the requirements of the system under construction. This process includes two main activities: requirements elicitation and analysis. Requirements elicitation focuses on describing the purpose of the system. Recall the distinction made in the GSDP of the function or behavior perspective as oppose of the construction and operation perspective on systems. Recall also, that it was concluded that the model for conceptualizing the IT-systems should be a functional model. Now, the requirements elicitation process includes several activities resulting in a system specification model ([*Bruegge and Dutoit*, 2003]).

The first activity in requirements elicitation is the identification of actors, where actors are defined as the users of the IT-system. In software engineering, IT-system may be the user of another IT-system. These types of electronic users are omitted since the objective is to assess the support the IT-system provides to the organization. Thus how do actors (which are human beings) use provided functions. The next activity of the requirement engineering process is determining the function that the IT-system should provide to the identified users. Of course, these activities result in representation models, providing the required information. An example of such a model is the UML use case diagram. This diagram provides system boundaries, system function, system users and the relation between functions and users. These relations depict which functions are used by which users.

Summarizing the above, models for representing the system function and the system users and their relation are required. The system boundaries are addressed, if an IT-system consists of subsystems or if a business process is supported by more than one system. Note now that in the implementation of the organization as an aspect model of the assessment framework, the activities coincide with possible functions and the subjects fulfilling actor roles coincide with IT-systems' users. The functional model of existing IT-systems, as a conceptual model of the assessment framework, consists of a 'function identification' model, 'functional decomposition' model and a 'user distribution' model. Figure 5.1 depicts the structure of the functional model of IT-systems. The 'function identification' model consists of tables which contain required information for the assessment the supporting IT services. In addition, it provides a consistency table which is the result of the assessment of the IT-system functions. The 'subsystem decomposition' model consists of one table depicting the support different subsystems provide. The 'user distribution' model consists of tables which provide required information for the assessment of the user distribution of the concerning IT-system. In addition it provides a consistency table which is the result of the assessment of the user distribution. The tables defined in the functional model of IT-systems are specifically defined for the assessment framework.

5.2 Identification of IT- System Functions

5.2.1 Electronic Support Table

The electronic support table (EST) depicts which activities are allowed to be supported or replaced by electronically provided functions by an IT-system. The structure of the EST is identical to the BID-activity table of the implementation model. The entries are empty. If an activity in the BID-activity table is allowed to be supported or replaced by electronic functions provided by IT-systems, the corresponding entry of the EST is colored. The B-activities, I-actives and D-activities are respectively colored red, green and blue [1]. This table is generic, in the sense that it may be filled in, regardless of which IT-system is assessed. Note that the information this table provides, may be used for the identification of possible electronic support for the development of new IT-system.

5.2.2 Function Identification Table

The function identification table (FIT) depicts which activities are actually supported or replaced by electronically provided functions by the IT-system which is subject to the assessment. The structure of the FIT is identical to the one of the BID-activity table. The B-,I- and D- columns are now called B-function, I-function and D-function. Only the entries corresponding with the entries of the BID-activity table containing activities that are electronically supported or replaced, are filled in. The knowledge provided in the FIT is partly inferred from the BID-activity table and the models of the IT-system provided by the vendor. The functions of the IT-system are matched with the activities defined in the BID-activity table. If a 'match' is found, meaning an activity is either electronically supported or replaced, the description of the supporting function is put in the corresponding

[1] these specific colors are adopted from the colors of the B-, I- and D-organization depicted in [*Dietz*, 2006]

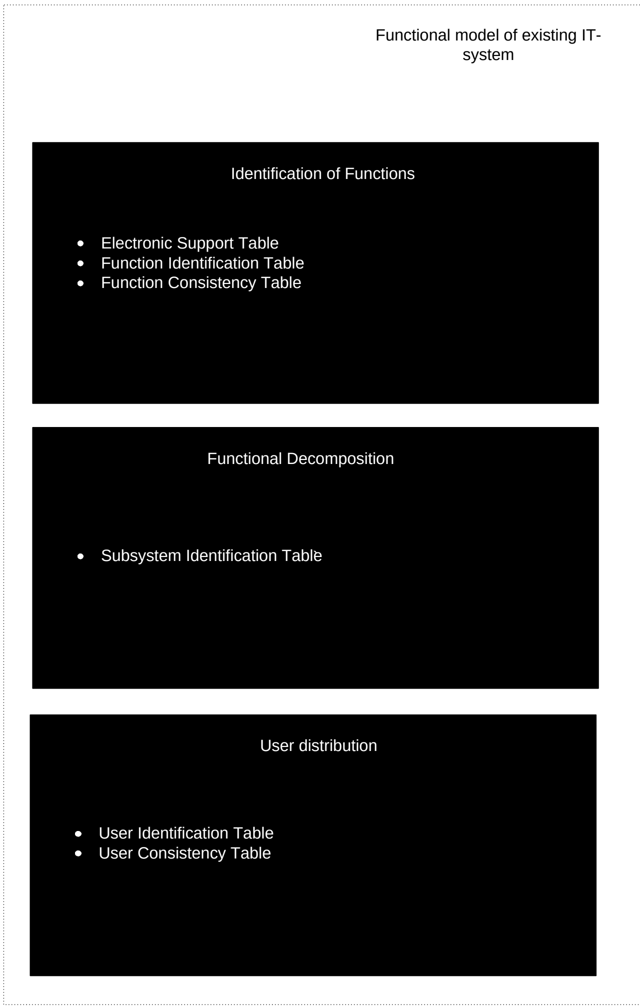

Figure 5.1

Functional Model of IT-systems

entry of the FIT. Other entries are empty. Note here that in the case of the development of a new IT system, this table in combination with EST, may be used for determining which activities should be electronically supported or replaced. In this case the entries of the FIT contain the description of required functions of a new system. Table A.6 depicts a colored FIT of the salary process. This is actually the integration of the EST and FIT. The relevance of integrating these tables is explained in the next section.

5.2.3 Function Consistency Table

The function consistency table (FCT) shows the completeness and correctness of the provided electronic functions. The structure of the FCT is identical to the FIT. The entries are non-colored. Note that first that the structures of the EST and FIT are the same. In addition consider the following: Let the EST be printed on a transparent sheet and the FIT be printed on a sheet of the same size. Then if the EST sheet is placed on top of the FIT sheet the cell borders fit exactly together.[2]. In this way the FIT and EST are integrated. The best case scenario is when all the colored cells of the EST are not empty and the non-colored (white) ones are. If colored cells are not empty, is can be concluded that the

[2] of course the assumption is made that the column width and row width is exactly the for both tables

corresponding activity is supported, the entries are marked *supported* . If colored cells are empty it can be concluded that the IT-system is not complete, the corresponding entries are marked *incomplete* . This is not necessarily a problem, because it may have been a conscious choice during requirement elicitation. However, if it was not chosen to be, the CST provides sufficient information for discussions on this matter. When non-colored cells are not empty it can be concluded that activities of which it was decided that electronic support or replacement was prohibited, are electronically supported or replaced. In this case, the coinciding entry of the FCT is marked*inconsistent* . The 'incomplete' and 'inconsistent' entries should be subject of discussion in the assessment of the concerning IT system.

5.3 Functional Decomposition

5.3.1 Subsystem Identification Table

The subsystem identification table (SIT) depicts the subsystem in which activities are electronically implemented. The structure of the SIT and the FIT are identical. The B-,I- and D-columns are now called B-app, I-app and D-app. The entries are now filled in with the name of the concerning subsystem. The entry colors are exactly the same as the ones of the corresponding EST. Note that it is not possible to enter a subsystem name in an entry of the SIT, if the corresponding entry in the FIT is empty. The knowledge provided in the SIT is partly inferred from the FIT and the models of the IT-system provided by the vendor. The subsystem identification model is only applicable in the case where one business process is supported by more than one systems or where one subsystem supports more than one business processes. Note here that the information provided in the SIT may trigger discussions on IT-system integration on a high level of abstraction, where integration concerns the integration of the IT-systems' functions.

Consider the case where one business process is supported by several (sub)systems. Note first that for every business process an instance of the SIT is created analogous to the BID-activity table. Now two cases may occur. In the first case two subsystems cover two successive rows of the D-application column in the SIT. Of course these will be colored rows. These two (sub)system are considered to be correctly integrated. An example of a correct integration of two subsystems appears in table A.8. It concerns the integration of the FINIS BUCS subsystem and the FINIS betaalsysteem. In the second case a colored cell in the D-column is empty but its predecessor contains (sub) system A and its successor contains a different (sub)system B. These two subsystems may not be integrated properly. For instance, it may be necessary to print the output of A and manually input the information in B. Such a case leads to a more technical discussion on (sub)system integration. The incorrect integration of the salary information system and the FINIS BUCS (see also table A.8) provides an example of such a case.

Consider the case where one (sub)system supports more than one business processes. In this case it can be discussed if the business processes should indeed be electronically integrated. This discussion on (sub)system integration should be performed on a management level. The SIT is also suitable for identifying (sub)systems for the development of new IT-systems.

5.4 Identification of User Roles

5.4.1 User Identification Table

The user identification table (UIT) depicts the users of the (sub)systems identified in the SIT. The structure the UIT is identical to that of the SIT and FIT. The B-,I- and D- columns are now called B-user, I-user and D-user. The knowledge provided in the UIT is inferred from the design models of the IT-systems provided by the vendor. The users coincide, within the context of the assessment framework, with organizational departments. As was already explained, the functional hierarchy within the departments is omitted within the scope of this research. Table A.10 depicts the UIT of the salary process.

5.4.2 User Consistency Table

The user consistency table (UCT) shows the correctness of user assignment within the concerned IT-system. The structure of the UCT is identical to that of the UIT. The entries are non-colored. Now recall the BID-actor table of the implementation model. In this table departments were assigned authorizations for the fulfillment of actor roles. In the best case scenario, the colored entries of the UIT contain exactly the same responsible actors as the BID-actor. In this case the corresponding entries are marked *correct* . An exception is an external actor delivering information on paper as a request, and an internal actor role electronically documenting this information. This case coincides with the request process steps of customer transactions. In that case the user of the systems takes over the role of the requesting actor in electronically executing the D-activity. In this case the corresponding entry is marked *correctly taken over* . Any other case, in which entries of the UIT do not coincide with the entries of the BID-actor table is marked *incorrect* . The 'incorrect' entries should be subject of discussion in the assessment of the concerning IT system.

5.5 Producing the Functional Model

The functional model of the IT system to be assessed is constructed after the construction of all of the specified functional aspect models: 'Function Identification', 'Subsystem decomposition' and , 'User identification'. The EST is the first table to be constructed. The information it provides is used in the production of all other tables. The remaining tables should successively be produced as follows: FIT, FCT, SCT, UIT and UCT. Note that the FCT, SCT and UCT open the relevant discussion for the proper assessment of the concerning IT system.

As described above, the EST, FIT, SCT and UIT may also be used for the development of new IT systems. In that case, the EST is used for defining the activities that require IT support. The FIT then contains the required IT functions. The SCT provides a picture of possible subsystems and opens discussions on IT integration. The user role assignment is then depicted in the UIT. The order in which these tables should be implemented is similar as when they are used for assessment. Of course, since it concerns the design of a new systems, the process of producing these tables will be iterative.

Chapter 6

Conclusion and Recommendations

This chapter is the concluding chapter of this report. First the developed assessment framework is evaluated. Next recommendations for possible extensions of the framework are provided.

6.1 Evaluation of the Framework

6.1.1 Theoretical Foundation of the Framework

The framework is primarily based on the Generic System Development Process. The notion and definition of the GSDP aspect are used in the argumentation and justification of the aspect models of the assessment framework. The Design and Engineering Methodology for Organizations (DEMO) is used for expressing the ′ontology of the organization′. As was described, this methodology is founded by an well-defined theoretical base. In particular the ψ theorem is used for the construction of the tables for expressing both the ′implementation of the organization′ and the ′functional model of the organization′. In addition, concerning aspects of the traditional requirements elicitation process are used for determining the aspect models of the ′functional model of the organization′.

6.1.2 Practical Usefulness of the Framework

Since the ′ontology of the organization′ is only expressed with DEMO diagrams and tables, the practical relevance of the DEMO aspect models also apply on this aspect model of the assessment framework. The ′organizational system′ model showS boundaries of the (sub) organization and the relation with environmental actors. With the introduction of government subsystem, the essence of the relation between government subsystems can be directly inferred from the ATD.

The ′business process′ model provides enough sufficient insight for the assessment of the implementation of the organization, the assessment of IT systems and the elicitation of IT systems′ requirements. The DEMO PSD and Action Rule Table open the discussion for the implementation of the business processes. Decisions made as a result of these discussions are constituted in the BID-activity table. This table provides a base for eliciting the functionality of IT systems. In the case of existing IT systems, the functionality may be evaluated using this table.

The authorization hierarchy provides a base for identifying government subjects for the assignment of actor roles. The distinction between the different levels of authorization, contributes to the definition of accountability rules within the organization. In addition the BID-actor table provides a base for identifying user roles and assigning them to government department. In the case of existing IT systems, the correctness and completeness of user role assignment may be evaluated using this table.

Given the above, the 'Organization As-Is' provides a thorough insight and representation models for re-engineering and re-implementing the organization. In addition it is the applied norm in the assessment of IT systems or the applied base for developing new IT systems.

The functional aspects of IT systems are constituted in the Function Identification Table, User Identification Table and Subsystem Decomposition Table. These tables may be produced during the development of new IT system or inferred from the design of existing IT systems. The Function Consistency Table and User Consistency Table are the result of the evaluation of the FIT and UIT. These tables are specifically constructed for the assessment of IT systems. In combination with the Subsystem Decomposition Table, these tables open relevant discussion for a proper assessment of the concerning IT system on both the management and operational level.

6.1.3 Stimulating awareness

The framework is primarily constructed for assessing IT system. The Ministry is acquainted with the current state of the organization and existing IT systems. This, because of the daily execution of business processes and use of the existing IT systems. Currently, the business processes and IT systems are only viewed and addressed from an operational perspective. The framework provides guidelines for producing the defined diagrams and tables. Intensively adopting the framework by producing these diagrams and tables and discussing relevant issues will provide the Ministry a better notion of its organization, existing IT systems and IT integration. This may stimulate the Ministry to properly participate in IT projects.

6.2 Recommendations

6.2.1 Improving the Organization

As described above the 'Organization As-Is' provides sufficient information for re-engineering and re-implementing the organization. Since the objective was to develop an assessment framework, guidelines for identifying incompleteness, incorrectness and inconsistencies within the organization are not provided. In the application of the framework within the Directorate of Finance some inconsistencies have been observed. Since the representation of the complete organization is introduced within the framework, accompanying guidelines for identifying such bottlenecks will be useful.

6.2.2 Information Model for IT systems

A diehard software engineer should have observed the absence of an information model for IT systems in the assessment framework. However, it was not defined in the assessment framework. The 'information distribution' model provides the ontological view on information. A information model can easily be inferred from this ontological model analogous to the way in which the 'function identification' model and the 'user distribution' model respectively relate to the 'business process' model. As of now, the relation between the functionality and user role is defined and depicted in the tables of the functional model.

6.2.3 Introducing User Roles

As explained in chapter 5, the functional model focuses on the actual users of the system. The user roles defined in a well-developed IT systems were chosen not to be taken into account. If, at some point, the Ministry is acquainted with the framework it might be useful to create a table containing user roles. Such a table contains sufficient information for assessing user role assignment. Note that the authority hierarchy should first be extended before introducing the notion of user roles.

Appendix

A

Produced Diagrams and Tables

Transaction	**Resulting P-fact**
T01 Operationalize budget	Budget B for Year Y has been operationalized
T02 Propose budget	Budget B for Year Y has been proposed
T03 Approve budget	Budget B has been approved
T05 Operationalize budget change	Budget change BC for Year Y has been operationalised
T04 Approve budget change	Budget change BC for Year Y has been operationalised
T09 Grant periodic fund	Periodic fund PF has been granted
T08 Grant incidental fund	Incidental fund IF has been granted
T10 Approve incidental fund	Incidental fund IF has been approved
T13 Process order	Order O has been processed
T11 Deliver order	Order O has been delivered
T12 Pay order	Order O has been paid
T19 Process salary	Salary S has been processed
T20 Realize Salary	Salary S has been realized
T22 Pay Salary	Salary S has been payed

Table A.1

TRT of Budget Cycle Organization

Actor	Agendum	Condition	Action
A19	REQUESTED T19 (SA, M)		PROMISE T19 (SA, M) REQUEST T19(SA, M+1)
	PROMISED T19(SA, M)	DO FOR ALL EMPLOYEES	REQUEST T20(SA, M)
	STATED T20(SA, M)	SALARY CALCULATION IS NOT ACCEPTED	REJECT T20(SA, M)
		SALARY CALCULATION IS ACCEPTED	ACCEPT T20 (SA, M)
	ACCEPTED T20 (SA,M)	DO FOR ALL SALARIES	REQUEST T22 (SA,M)
	DECLINED T22(SA,M)		REQUEST T20(SA,M)
	STATED T22 (SA,M)		ACCEPT T22(SA,M)
	ACCEPTED T22(SA,M)		EXECUTE T19(SA,M) STATE T19(SA,M)
	STATED T19 (SA,M)		ACCEPT T19 (SA,M)
A20	REQUESTED T20(SA,M)		PROMISE T20(SA,M)
	PROMISE T20(SA,M)		EXECUTE T20(SA,M) STATE T20(SA,M)
A22	REQUESTED T22(SA,M)	SALARY IS NOT ACCEPTED	DECLINE T22(SA,M)
		SALARY IS ACCEPTED	PROMISE T22(SA,M)
	PROMISED T22(SA,M)		EXECUTE T22(SA,M) STATE T22(SA,M)

Table A.2

Action Rules Salary Process

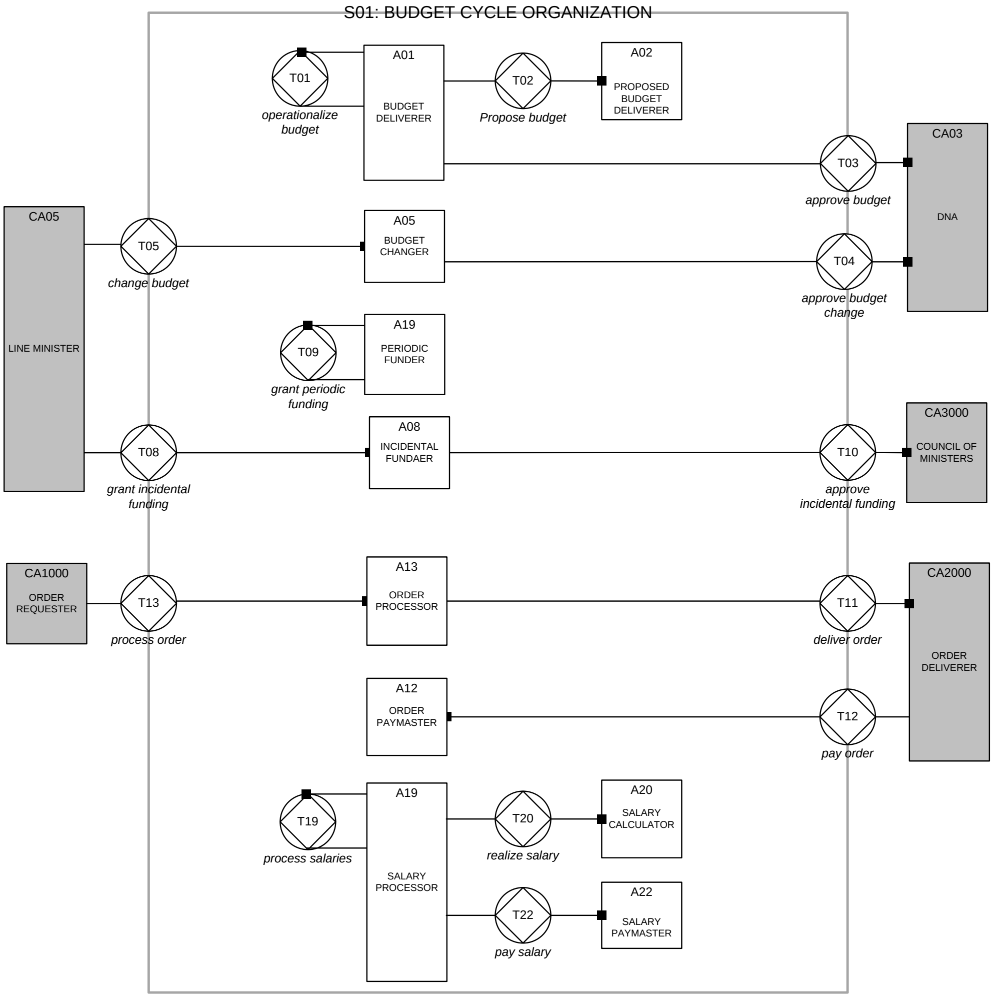

Figure A.1

ATD of Budget Cycle Organization

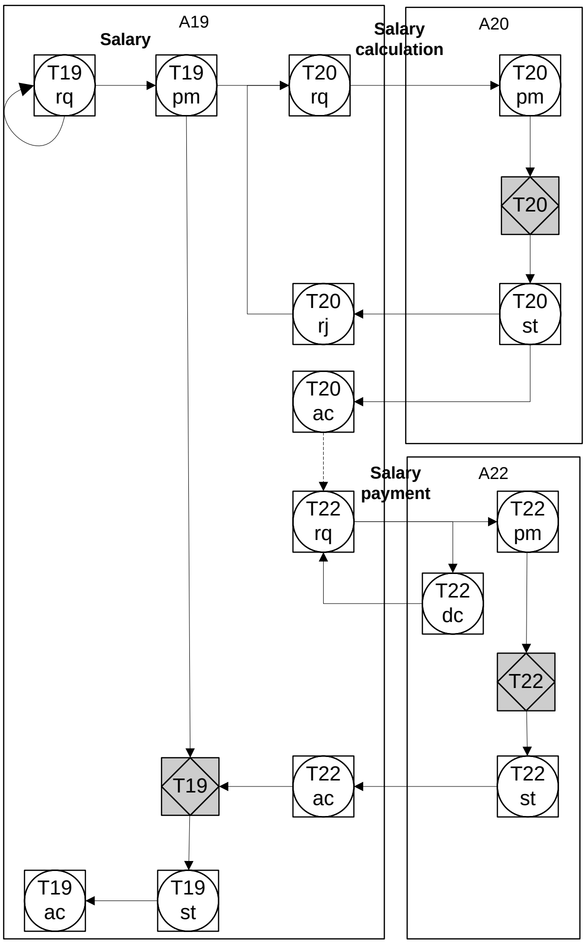

Figure A.2

PSD of the Salary Process

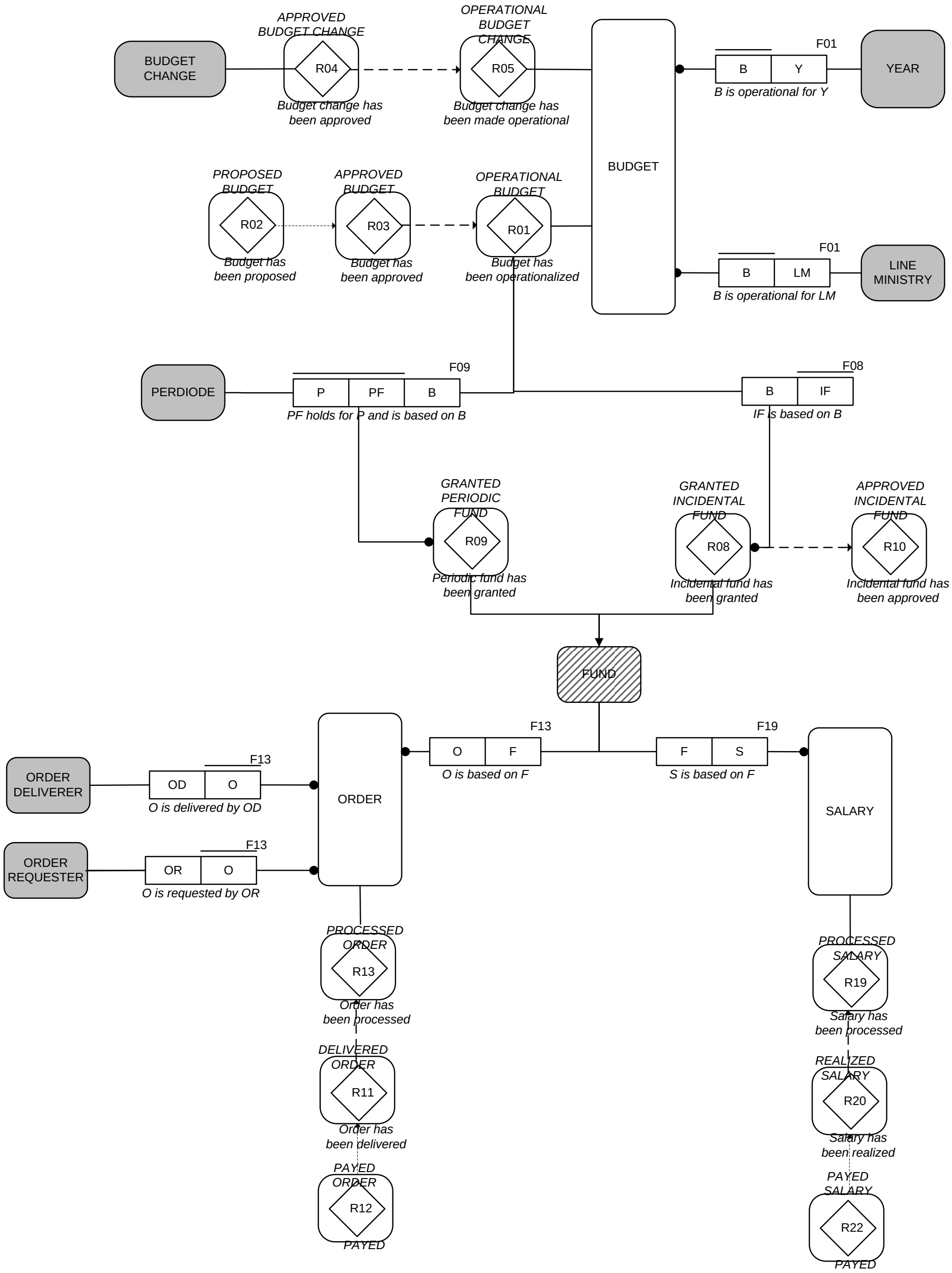

Figure A.3

FRD of the Budget Cycle Organization

Object class	**CREATE**	**USE**
BUDGET		T01/rq, T02/rq, T03/rq, T04/rq, T05/rq
B is for Y	T01/rq	T02/pm, T03/pm, T04/pm, T05pm
B is for LM	T01/rq	T02/rq, T05/pm, T03/pm, T04/pm
B has been operationalised	T01/ex	T01/st, T01/ac, T09/ex, T08/ex
B has been proposed	T02/ex	T02/st, T02/ac, T03/rq, T03/ex
B has been approved	T03/ex	T03/st, T03/ac, T03/rj, T01/ex
INCIDENTAL FUND		T08/rq
IF is based on B	T08/rq	T08/pm, T10/rq
IF has been granted	T08/ex	T08/st, T08/ac, T12/pm, T12/dc
IF has been approved	T10/ex	T10/st, T10/ac, T08/ex
PERIODIC FUND		T09/rq
PF is based on BG	T09/rq	T09/pm
PF has been granted P	T09/ex	T09/st, T09/ac, T12/pm, T12/dc, T22/pm, T22/dc
ORDER		T13/rq
O is requested by OR	T13/rq	T13/pm, T11/ac, T12/pm, T12/dc
O is delivered by OD	T11/rq	T12/ex, T12/st
O is based on F	T13/pm	T11/ac, T12/pm, T12/dc
O has been processed	T13/ex	T13/st, T13/ac
O has been delivered	T11/ex	T11/st, T11/ac, T11/rj,T12/pm, T12/dc, T13/ac
O has been paid	T12/ex	T12/st, T12/ac
SALARY		T19/rq
S is for M	T19/rq	T20/rq, T22/ex
S regards E	T19/rq	T20/rq, T22/ex, T22/st
S is based on PF	T19/rq	T19/pm, T22/pm, T22/dc
S has been processed	T19/ex	T19/ex, T19/st
S has been realized	T20/ex	T20/st, T20/ac, T20/rj, T22/pm, T22/dc, T22/ex
S has been paid	T22/ex	T22/st, T22/ac, T19/ex, T19/st
LINEMINISTRY		T01/rq
EMPLOYEE		T19/rq
ORDER REQUESTER		T13/rq
ORDER DELIVERER		T11/pm
YEAR		T01/rq
PERIOD		T09/rq
MONTH		T19/rq

Table A.3

IUT for the Budget Cycle Organization

Process step	**Role**	**Delegation/ Prpopagation**	**Institutional**	**Political/ Constitutional**
T19/rq	A19		PZ	Line Minister
T19/pm		CKB	BFZ	Line Minister
T20/rq		CKB	BFZ	Line Minister
T20/pm	A20	CKB	BFZ	Line Minister
T20/ex		CKB	BFZ	Line Minister
T20/st		CKB	BFZ	Line Minister
T20/rj	A19	CKB	BFZ	Line Minister
T20/ac		CKB	BFZ	Line Minister
T22/rq		RECU	BFZ	Line Minister
T22/dc	A22		Comptabiliteit	Minister of Finance
T22/pm			Comptabiliteit	Minister of Finance
T22/ex		CBD	Comptabiliteit	Minister of Finance
T22/st		CBD	Comptabiliteit	Minister of Finance
T22/ac	A19	N/A	N/A	N/A
T19/ex		CBD	BFZ	Line Minister
T19/st		CBD	BFZ	Line Minister
T19/ac			PZ	Line Minister

Table A.4

Actor Responsibility Table for the Salary Process

Proces Step	B-act	I-act	D-act
T19/rq	initiate salary process		
T19/pm	promise salaries	produce salary information	document salary information
T20/rq	request salary realization	provide salary information	present salary documentation
T20/pm	promise salary realization	process salary information	present salary documentation
T20/ex	produce salary	calculate salary	document salaries list
T20/st	state salary	provide salary	present salary list
T20/rj	reject salary	check salary	read salary list
T20/ac	approve salary	check salary produce payment information	read salary list document payment form
T22/rq	request salary payment	provide payment information	present payment form
T22/dc	reject payment	check credit check correctness of payment information	read credit and funding dcumentation read payment form
T22/pm	promise payment	check credit check correctness of payment information	read credit and funding dcumentation read payment form
T22/ex	realize payment	pay salary confirm payment	read payment form document payment information present payment receipt
T22/st	realize payment	pay salary confirm payment	present payment information documentation document payment information present payment receipt
T22/ac	N/A		
T19/ex	realize payment	pay salary confirm payment	present payment information documentation document payment information present payment receipt
T19/st	realize payment	pay salary confirm payment	present payment information documentation document payment information present payment receipt
T19/ac	N/A		

Table A.5
BID-activity Table for the Salary Process

Proces Step	B-Function	I-Function	D-Function
T19/rq			
T19/pm			
T20/rq			input salary information
T20/pm		process salary information	read salary information
T20/ex		calculate salary	save salary list
T20/st		provide salary	print salary list
T20/rj			
T20/ac		produce salary payment information	input salary list save salary payment information
T22/rq		provide salary payment information	display salary payment information
T22/dc		check credit	read credit and funding information display salary payment information
T22/pm		check credit	read credit and funding information display salary payment information
T22/ex			read salary payment information input salary payment confirmation print salary payment receipt
T22/st			read salary payment information input salary payment confirmation print salary payment receipt
T22/ac			
T19/ex			read salary payment information input salary payment confirmation print salary payment receipt
T19/st			read salary payment information input salary payment confirmation print salary payment receipt
T19/ac			

Table A.6
Function Identification table for the Salary Process

Proces Step	B-Function	I-Function	D-Function
T19/rq			
T19/pm			
T20/rq		incomplete	supported
T20/pm		supported	supported
T20/ex		supported	supported
T20/st		supported	supported
T20/rj		incomplete	supported
T20/ac		incomplete supported	supported supported
T22/rq		supported	supported
T22/dc		supported incomplete	supported supported
T22/pm		supported incomplete	supported supported
T22/ex			supported supported supported
T22/st			supported supported supported
T22/ac			
T19/ex			supported supported supported
T19/st			supported supported supported
T19/ac			

Table A.7

Function Consitency table for the Salary Process

Proces Step	B-System	I-System	D-System
T19/rq			
T19/pm			
T20/rq			Salary Information System
T20/pm		Salary Information System	Salary Information System
T20/ex		Salary Information System	Salary Information System
T20/st		Salary Information System	Salary Information System
T20/rj			
T20/ac		 FINIS BUCS	FINIS BUCS FINIS BUCS
T22/rq		FINIS BUCS	FINIS BUCS
T22/dc		FINIS BUCS	FINIS BUCS FINIS BUCS
T22/pm		FINIS BUCS	FINIS BUCS FINIS BUCS
T22/ex			FINIS betaalsysteem FINIS betaalsysteem FINIS betaalsysteem
T22/ex			FINIS betaalsysteem FINIS betaalsysteem FINIS betaalsysteem
T22/ac			
T22/ex			FINIS betaalsysteem FINIS betaalsysteem FINIS betaalsysteem
T22/ex			FINIS betaalsysteem FINIS betaalsysteem FINIS betaalsysteem
T19/ac			

Table A.8

System Identification Table for the Salary Process

Proces Step	B-actor	I-actor	D-actor
T19/rq	PZ	PZ	PZ
T19/pm	CKB	CKB	CKB
T20/rq	CKB	CKB	CKB
T20/pm	CKB	CKB	CKB
T20/ex	CKB	CKB	CKB
T20/st	CKB	CKB	CKB
T20/rj	CKB	CKB	CKB
T20/ac	CKB	CKB CKB	CKB CKB
T22/rq	RECU	RECU	RECU
T22/dc	Comptabiliteit	Comptabiliteit Comptabiliteit	Comptabiliteit Comptabiliteit
T22/pm	Comptabiliteit	Comptabiliteit Comptabiliteit	Comptabiliteit Comptabiliteit
T22/ex	CBD	CBD CBD	CBD CBD CBD
T22/st	CBD	CBD CBD	CBD CBD CBD
T22/ac	N/A		
T19/ex	CBD	CBD CBD	CBD CBD CBD
T19/st	CBD	CBD CBD	CBD CBD CBD
T19/ac	N/A		

Table A.9

BID-actor Table for the Salary Process

Proces Step	**B-User**	**I-User**	**D-User**
T19/rq			
T19/pm			
T20/rq			**CEBUMA**
T20/pm		**CEBUMA**	**CEBUMA**
T20/ex		**CEBUMA**	**CEBUMA**
T20/st		**CEBUMA**	**CEBUMA**
T20/rj			
T20/ac		 **RECU**	**CKB** **RECU**
T22/rq		**RECU**	**RECU**
T22/dc		**Comptabiliteit**	**Comptabiliteit** **Comptabiliteit**
T22/pm		**Comptabiliteit**	**Comptabiliteit** **Comptabiliteit**
T22/ex			**CBD** **CBD** **CBD**
T22/st			**CBD** **CBD** **CBD**
T22/ac			
T19/ex			**CBD** **CBD** **CBD**
T19/st			**CBD** **CBD** **CBD**
T19/ac			

Table A.10

User Identification Table for the Salary Process

Proces Step	B-User	I-User	D-User
T19/rq			
T19/pm			
T20/rq			inconsistent
T20/pm		inconsistent	inconsistent
T20/ex		inconsistent	inconsistent
T20/st		inconsistent	inconsistent
T20/rj			
T20/ac		correct	correct correct
T22/rq		correct	correct
T22/dc		correct	correct correct
T22/pm		correct	correct correct
T22/ex			correct correct correct
T22/st			correct correct correct
T22/ac			
T19/ex			correct correct correct
T19/st			correct correct correct
T19/ac			

Table A.11

User Consistency Table for the Salary Process

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