Accounting information for changing business needs

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Part IV: Validation

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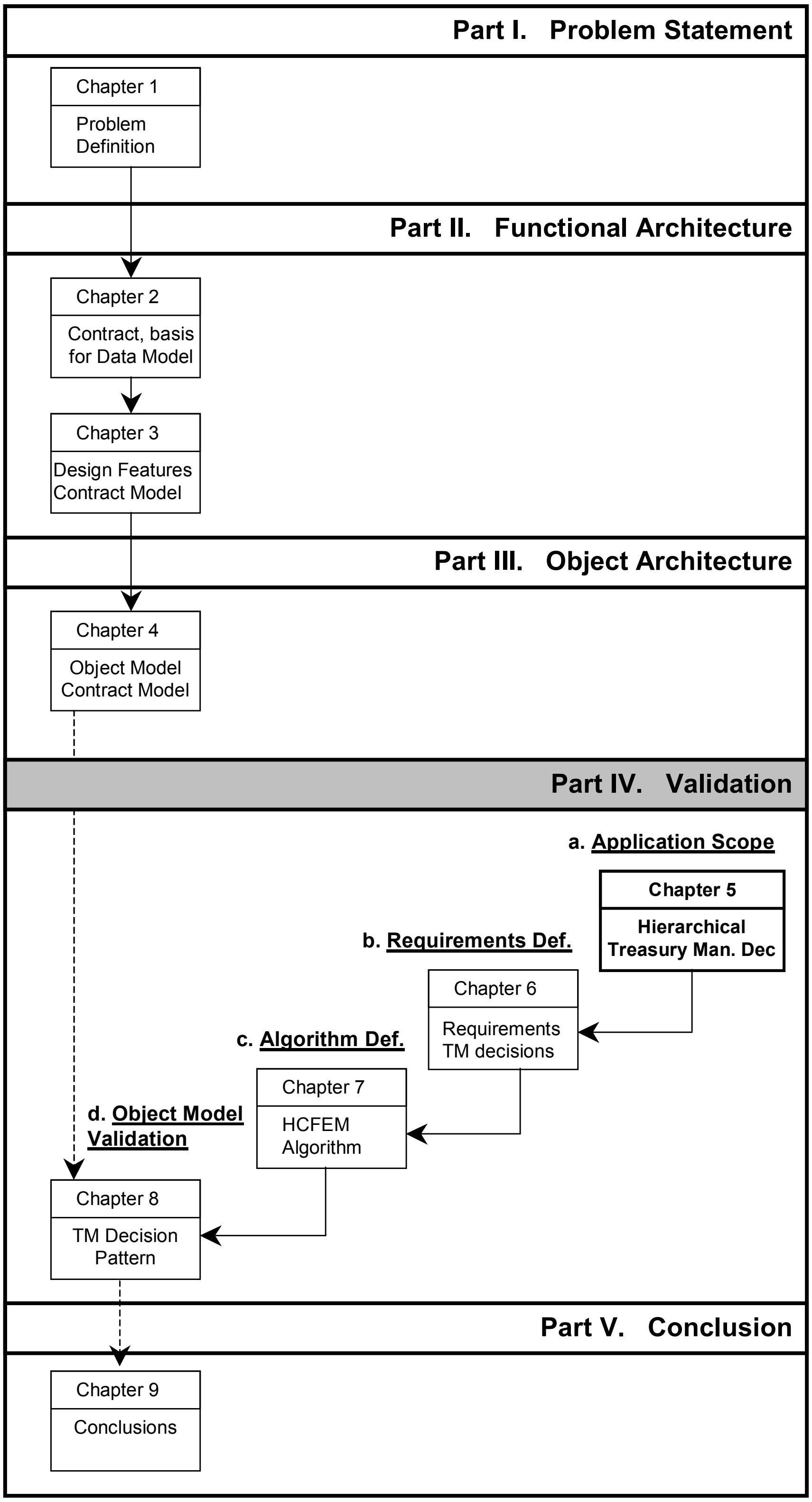
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5.1 Introduction

Part four of this research consists of a validation of the newly proposed accounting data model, i.e. the contract data model discussed in Chapters 2, 3 and 4. The validation concentrates on the question of whether the contract data model can hold sufficient data to support existing and new applications. As a representative new application, our choice concerns the support of hierarchical treasury management decision-making with appropriate accounting data. This is the first of four chapters, describing a solution for research objective two 2 as outlined in Section 1.4 of Chapter 1:

Research Objective 2: To propose a framework of hierarchical treasury management decisions where *ex post* and *ex ante* accounting information is used for decision support in information systems.

The validation is discussed in four consecutive chapters. This chapter outlines a hierarchical framework for treasury management decisions as a definition of the scope of the application chosen to be validated and provides an answer to research question one of research objective two as outlined in Section 1.4 of Chapter 1.

Research Question 1: How should a framework of hierarchical treasury management decisions based on concepts of business logistics be defined?

This chapter is structured as follows. First, the purpose of the treasury management application is placed in the context of the validation of this research in Section 5.2. Then, a comparison between financial and operational resource optimization is provided in Section 5.3. Section 5.4 goes on to present the scope of treasury management decisions. Subsequently, in Section 5.5, three different approaches to treasury management decision-making are discussed, namely decentralized, centralized and hybrid decision-making. Treasury management decisions are derived, applicable per type of decision-making model, and their relative advantages and disadvantages are presented. The hybrid approach to decision-making is proposed as the most comprehensive framework for hierarchical treasury management decision-making. Section 5.6 details this approach to treasury management decision-making. Finally, a summary and some concluding remarks are presented in Section 5.7.

5.2 Position of the Treasury Management Application in the Context of the Validation

Chapters 2 to 4 defined the contract data model as a better approach to storing business process instance data. Part four concerns the validation of this data model. Several aspects could be the subjects of in-depth validation of this research. Three possible topics for validation are outlined here and the one chosen in this research will then be explained and justified.

First, the *development aspect* of the new data model could be focused on. This would result in questions like, can the data model be built and serve as a data source for an application? Can the data model serve as a data source for an application source as elaborated in a large ERP system? If not, what is the nature of the bottlenecks? (One example could be poor performance in data retrieval). For a thorough and complete validation of these questions, several prerequisites would have to be addressed first. It would require the proposed contract data model to be built. In order to be representative, it would not be sufficient to build the data model for an application in isolation (e.g. a prototype or small application), but rather, it would have to be built to act as a data source for a large business information system, like an ERP system. Only if this were achieved could the next steps be taken, consisting of answering the questions as described above.

Second, validation could be concentrated on the customer *implementation and deployment aspect*. In this context, the following questions could be investigated. Can the data model serve as a data source for a large customer implementation consisting of multiple sites at different geographical locations? This type of implementation is further characterized by consequences in operating in a dynamic environment, raising questions like, what happens to data provision when sites are added (e.g. as a result of acquisition) or sites are sold (e.g. because of a divisional sell-off)? Can multiple users working at different locations concurrently extract data and update the contract data model without significant technological limitations (e.g. on performance)? Full validation of the implementation and deployment aspects would first require full validation of the development aspect as discussed in the previous paragraph, since an ERP system with a data source based on the contract data model would have to be available first. Subsequently, this ERP system would need to be implemented in a representative customer situation. This would imply that several customer sites with several different types of information user, both internal and external, would have to be implemented with the data model being populated with a sufficient volume of data, etc. Later, this implementation would have to be monitored over a period sufficient to understand to what extent the contract data model can continue to hold data to support information needs in a dynamic environment where new users start using the information system and customer sites are added or removed from its implementation.

Third, the validation could aim at determining the *completeness of data stored*. This is the question of whether or not sufficient data can be provided to support the existing, new and changing information needs of various internal and external information users. In this aspect of validation, the focus is on the question of whether the data held in the contract data model are sufficiently complete to support the information needs supported by ERP systems today and in the future. For this validation, the development aspect (‘can the data model be built?’) and the implementation aspect (‘can the data model be deployed in large ERP implementations?’) can be left out of scope. Validating the completeness of stored data requires the investigation of whether in the most complex scenario envisaged (namely, ‘a new application which does not exist today’) data can be provided by the contract data model. It is an explicit requirement in supporting existing applications with data provided by the contract data model. However, in order to validate the capabilities of data provision without enhancing or modifying the contract data model, the data provision requirements have to go beyond the capabilities of today’s ERP data models. A validation with a new application is therefore the preferred approach.

In this research, the accounting data model has been validated from the perspective of data completeness (i.e. the third aspect) alone. Limitations on time and resources allocated to the execution of this research are the reasons for this choice. Had validation on the development aspects as described above been opted for, this would have entailed producing the contract pattern model as defined in Chapter 4. This would have involved writing a conceptual design to be developed into the data model for an ERP application. It would also have required all the data model queries and data model updates to be redefined to work with the contract data model, together a very elaborate exercise requiring several hundred days work to accomplish. Owing to this resource claim, the development aspect was not considered further for validation. For similar reasons, the customer implementation aspect was also not validated. In addition to building the data model into an ERP system, validation based on the implementation aspect would also require the customer to migrate from an existing ERP system to a new ERP system with the contract data model as its central data source. Having already chosen not to build the data model into an ERP system, validation of this aspect was impossible. In any case, it is sufficiently well known that customer migrations are invariably very costly, often overrunning the financial and time budgets defined for them. These reasons rendered validation of the implementation aspect unfeasible within the scope of this research.

As described earlier, the aspect subject to validation in this research was the *completeness of data* for supporting existing and new applications. The choice to support a new application, currently unsupported by existing ERP system data models, is grounded in the belief that it corresponds most closely to the reality of the dynamic environment in which these information systems have to operate. The application for validation was outlined as 'hierarchical treasury management decision-making based on relevant cost information'. A comparable application already exists in business logistics (Verdaasdonk, 1998). In order to have a new application for validation, the concept of hierarchical decision-making based on relevant costs was defined for the domain of treasury management. The objective of the validation is to demonstrate that the data model could hold sufficient data to support this new application. The target audience of this part of the research is therefore primarily large ERP system architects, wanting to design this treasury management application as a logical part of an ERP system, and not treasurers whose daily activities consist of making these treasury management decisions.

The following four steps have been taken in Part Four of this research to execute the validation. Step one concerns the definition of the scope of the application for hierarchical treasury management decision-making (this chapter). Step two outlines the requirements for data availability in supporting treasury management decisions with relevant costs (see Chapter 6). Step three defines the data requirements for an algorithm to support any treasury management decision alternative with relevant cost information (see Chapter 7). Step four validates whether the contract data model can hold sufficient data to support the new application for hierarchical treasury management decision-making with relevant cost information (see Chapter 8).

5.3 Comparison between financial and operational resource optimization

Financial resource flows, the subject of treasury management decisions, are comparable to operational resource flows as discussed in business logistics. Researchers and practitioners have therefore concentrated their efforts on redefining business logistics algorithms to be used in the context of treasury management processes to benefit from the same opportunities for resource optimization (see e.g. Swagerman, 2000; Swagerman and Wassenaar, 1998 etc.). The availability of a hierarchical decision-making framework where treasury management decisions are expressed at multiple levels and in relation to each other is a prerequisite for the application of advanced business logistics algorithms in treasury management.

A comparison between operational resource optimization via business logistics decisions and financial resource optimization via treasury management decisions is provided to position the current status of business logistics algorithm reuse. Also to indicate how business logistics algorithms and -decision frameworks can be reused in another functional domain such as

Treasury Management, e.g. as demonstrated in this dissertation, to optimize hierarchical treasury management decision-making.

The extent to which business logistics principles are currently applied to treasury management is best explained by first presenting a high level overview on proceedings in business logistics. Overviews of the proceedings in production planning and control are, for instance, presented by Orliky (1975) and Thomas and McClain (1993), among others. Research into improved operational resource planning started in the late 1960s when traditional statistical inventory control techniques like stock replenishment and various techniques built around the economic order quantity proved to deliver results too inaccurate to serve a normal manufacturing situation (Orlicky, 1975, p. 5). Rather than focus on inventory prediction through demand forecast based on historical statistics data, researchers demonstrated that an indication of future inventory levels could be obtained more accurately via detailed planning of production orders. This resulted in the development of a new technique known as MRP-I (Material Requirements Planning). The concept of MRP-I concerns the planning of specific material and labour capacity needs per production order (see e.g. Orlicky 1975, Fogarty et al. 1991). Material purchase advice orders and/or labour capacity reservation orders are automatically generated in the event of a shortage of material or labour capacity availability. MRP-I plans against infinite capacity, implicitly overlooking restrictions to the available quantities of material or labour capacity within a give timeframe. This drawback was overcome by a more sophisticated production planning approach, MRP-II (Manufacturing Resource Planning), e.g. see Baker (1993), Chase and Aquilano (1995), Silver et al. (1998). MRP-II allows the support of business logistics decisions at multiple levels. Research into hierarchical production planning and decision-making originates from Bitran and Hax (1977), Bitran and Tirumpati (1993), Fransoo et al (1995) and Hax and Meal (1975). Restrictions applicable to lower-level decisions like material order acceptance, production or material order lot size determination, capacity expansion and safety stock level determination are governed by a higher level decision, i.e. ‘setting the Master Production Schedule’ (MPS) (see Giesberts 1993, 1991). This multi-level business logistics decision structure allows for decision-making under finite operational resource availability. Specific research towards redefining traditional MRP-I concepts to cater for the concept of finite operational resource planning has been described by e.g. Taal and Wortmann (1997).

Advances in financial resource planning in treasury management can be described in parallel with developments in business logistics. Quantities of financial resource needs were initially determined on the basis of forecasted operational and financial transaction data through so-called cash inventory models, see e.g. Baumol (1952). These forecasted data are projections of general ledger account balances at future moments and are derived from a sales demand plan. The algorithms applied in this type of financial resource projection are comparable to the statistical inventory techniques used in business logistics for operations resource projection. Insufficiently accurate information was provided to execute an efficient treasury management policy. For example, Baumol’s cash inventory model only worked well when a firm steadily consumed its cash balances. In search for more accurate information and an insight into financial resource flows under circumstances of more fluctuating financial resource demand, Miller and Orr (1966) presented a more sophisticated cash inventory model. An overview of the application of inventory cash management models is presented by Mullins and Homonoff (1976). At a later stage, when a systematic material requirements and labour capacity planning scheme (namely MRP-I) was introduced in the field of business logistics, sufficiently detailed information on planned operational activities was available to also plan financial resource availability on the basis of specific financial resource needs. Principles comparable to those of MRP-I, as applied in business logistics, were then also applied to treasury management. For example, as in MRP-I, financial resources are planned against infinite available capacity. The application of business logistics principles in treasury management is discussed by Swagerman (2000), Swagerman and Wassenaar (1998). Vandenbossche (1997) presented a model for infinite and finite financial capacity planning. In the field of treasury management, a next step comparable to hierarchical business logistics decision-making has yet to be developed. A treasury management decision allowing decision-making on the basis of constraints defined for lower-level decisions like a MPS (Master Production Schedule) decision in business logistics is not available.

5.4 Scope of Treasury Management Decisions

Short and medium-term treasury management decisions aim at solving two different categories of problem. The first category of treasury management decisions concerns optimizing[29] the physical financial resource flows. Examples include optimizing supplier payments, optimizing customer collections, optimizing interest payments, etc. The second category of treasury management decisions relates to identifying and hedging risk, possibly involved in financial transactions. Hill and Sartoris (1991) refer to two types of risk sources, namely business risks (e.g. financial asset value fluctuation) and financial risks (e.g. currency and interest rate risk).

It is important in the context of this research to choose a scope for validating whether the contract data model can hold sufficient data. Initially, the entire field of treasury management could be considered (i.e. optimizing the physical financial resource flows and financial risk optimization), with the aim of demonstrating that the contract data model could hold data for an entire functional domain. However, as explained in Chapter 2, Section 2.6.2 above, the scope within which the contract data model is to be able hold data is expected to be for those information needs that use data from contracts where the organization is one of the contracting parties. This is not an issue for treasury management decisions on financial resource flow optimization; the organization is always one of the contracting parties in transactions initiating financial resource flows (e.g. payments, collections, investments, etc.). As a result, it is expected that all the data required to support this application scope can be provided by the contract data model. This is therefore a representative application for verifying whether data can be provided by the contract data model. The situation is different for treasury management decisions that focus on risk optimization. There are two types of data required to support this type of decision. First, data are required to understand the volume of financial resources, in a specific currency at a specific location, exposed to possible risk. This type of data can be provided by the contract data model. Second, data are also required to understand the nature and magnitude of that risk, which could include macro-economic data, data on the political environment, data on money markets, etc. This type of data does not conform to the criterion of data that can be stored in the contract data model (more specifically, the organization is not one of the contracting parties in the definition of this type of data). Since the contract data model cannot hold this second type of data, support of financial risk optimization is out of the scope of the contract data model data provision. From a validation perspective, it is irrelevant to further focus on financial risk optimization. The scope of the validation is restricted to treasury management decisions aimed at financial resource flow optimization. The repercussions for (software) applications focusing on support of the entire treasury management field is that one or more additional data sources have to be defined to support the full range of information needs. With relevance to the scope of the contract data model, this outcome is a confirmation of the assertion made in Section 2.5 of Chapter 2 on the possible range of information needs that the contract data model might hold data for. This range does not coincide with a functional domain and has to be described in terms of 'type of data required'.

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[29] In 'optimization', the objective is to find the alternative with the least 'financial effort' (e.g. bank cost) or with the most 'financial benefit' (e.g. yield from an investment) out of a range of possible solutions.

As explained in the previous paragraph, only the first category of decisions (i.e. treasury management decisions focusing on financial resource flow optimization) is considered in the proposed treasury management decision-making frameworks as presented in the remaining part of this chapter. The objective is to provide a resource flow-based framework in which business logistics algorithms can be reused at a subsequent stage. For the chosen category of treasury management decisions, quantitative data relate to the volume of financial resources and the volume of 'financial effort' or 'financial benefit' involved in the execution of the decision. When volumes of 'financial effort' or 'financial benefit' are dependent upon a particular situation, this situation can also be expressed in quantitative terms. For example, the financial benefit received (e.g. interest percentage) is dependent on the volume invested and the period of investment. Various types of financial resources can be discerned, such as different types of loans (mortgage loans, straight loans, etc.), money available in bank accounts, different types of available credit lines, etc. Each financial resource is situated at a specific location, often a particular 'financial address'. The possible different financial resource flows are illustrated in Figure 5-1.

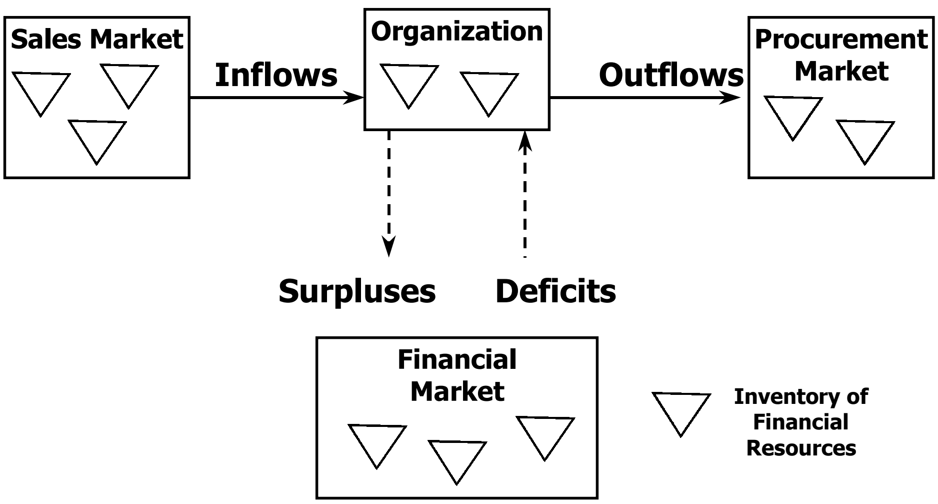

Figure 5-1. Different types of financial resource flows

Figure 5-1 visualizes the following four different financial resource flows:

a. *Financial resource inflows resulting from operations*. These flows result from an interaction between the organization and participants in the sales market. An example of this type of flow is customer collections (accounts receivable).
b. *Financial resource outflows resulting from operations*. These flows result from an interaction between the organization and participants in the procurement market. An example of this type of flow is supplier payments (accounts payable).
c. *Financial resource flows resulting from surplus investments*. These flows result from an interaction between the organization and participants in the financial market (demand side). Examples of this type of flow are outflows for investments in stock or options.
d. *Financial resource flows resulting from deficit financing*. These flows result from an interaction between the organization and participants in the financial market (supply side).

Two types of deficit financing can be discerned:

- *Conversion of financial resources*. Financial resources held in surplus are converted into financial resources held insufficiently (e.g. conversion of a cash amount in USD into a cash amount in JPY);
- *Expansion of financial resources*. New financial resources are acquired (e.g. incoming flow resulting from a new bank loan).

The following treasury management decisions can be derived from Figure 5-1:

1. To optimize Financial Resource Inflow Orders
2. To optimize Financial Resource Outflow Orders
3. To optimize Financial Resource Surplus Orders
4. To optimize Financial Resource Conversion Orders
5. To optimize Financial Resource Expansion Orders.

In the next section, it will be demonstrated that there are various approaches to making these treasury management decisions.

5.4.1 Decentralized treasury management decision-making

The decentralized approach to treasury management decision-making relates to where the five treasury management decisions as described in Section 5.4 are made at each financial division independently. Every financial division has control over a particular set of financial resources. Financial divisions cannot use financial resources allocated to another financial division. This can be illustrated by an example. An enterprise has its headquarters in New York and three financial divisions at the following locations: division 1, situated in Amsterdam; division 2, situated in Rotterdam; and division 3, situated in London. The following allocations of financial resources apply to each financial division[30]. Financial resources for the Amsterdam division are maintained at ABN-AMRO Amsterdam and ING Amsterdam; for the Rotterdam division, financial resources are maintained at ING Rotterdam and RABO Rotterdam; and for the London division, financial resources are maintained at NatWest London and the Midlands Bank London.

Each of the financial divisions has the freedom to determine its own norms for treasury management decision-making (e.g. the minimum amount of surplus investments at ABN-AMRO Amsterdam; the maximum financial effort (e.g. bank costs) accepted for inflow transactions; etc.). Optimization from within this approach is only possible within the limited scope of the financial resources defined for each division (e.g. financial resource pooling before a surplus investment is made). There is no option for overall optimization under the decentralized approach. It should be noted that the optimization could be made individually per decision, but it is not the aim here to strive for partial optimization of treasury management decisions. On the contrary, it is the objective to optimize financial resource flows across all organization activities. In this respect, overall norms like WACC (weighted average costs of capital) can be defined for all decisions together (following this approach, definition is local per division).

The treasury management decisions made in a decentralized system are presented in Figure 5-2. This figure illustrates that decentralized (local) norms on the execution of each of the five treasury management decisions are defined per division (depicted by the full arrows). When one decision is made (e.g. optimizing a surplus order), other decisions can be initiated by this decision (e.g. optimizing an inflow order). This is indicated by the line arrows. Under these circumstances, information on the execution of the later decision is returned and the earlier decision is updated with this information (depicted by the dotted arrows). The two next approaches to decision-making concern the centralized definition for the entire organization, or partially so between central and local divisions (see the hybrid approach to treasury management decision-making).

[30] In this example, the type of financial resource is not detailed further.

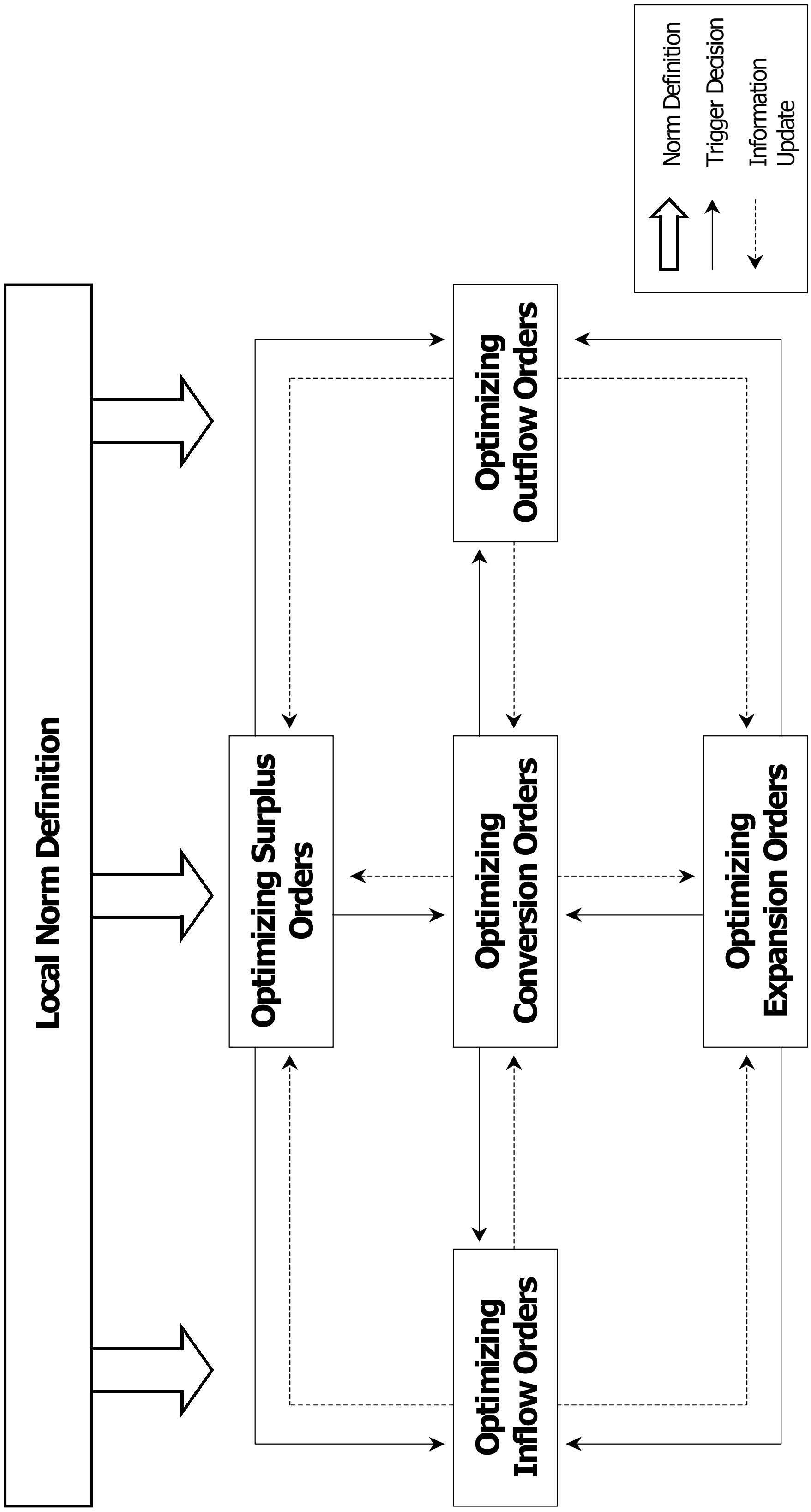

Figure 5-1. Decentralized treasury management decision-making

5.4.2 Centralized treasury management decision-making

It was demonstrated in the decentralized approach to treasury management decision-making that there were only limited optimization opportunities because treasury management decisions were made and optimized for every financial division individually. The overall enterprise situation could not be taken into account. This situation can be dealt with by going to the opposite extreme, namely considering the situation where the five treasury management decisions, described in Section 5.4, are made centrally. In the example presented in the previous section, this would imply that the treasury management decisions were made at the New York division. These decisions are then executed by the decentralized divisions (Amsterdam, Rotterdam and London), making use of the different types of financial resources at the various locations. However, in order to be able to make decisions at a central level, an overview of the availability of, and demand for different financial resources per location (e.g. ABN-AMRO Amsterdam, ING Amsterdam, etc.) must be available at all times. Only if this schedule is available, treasury management decisions can be optimized over different divisions centrally. A schedule of this kind is referred to as a 'Master Financing Schedule' (MFS). The MFS is a time-phased schedule per financial resource type per location. The MFS is similar to the Master Production Schedule (MPS) known to the field of operations management, which is used to plan the availability of materials and production capacity over different production sites, in order to fulfil the operational demand (end items or services) (Orliky, 1975). Since the MFS is similar to the MPS, it is now possible to apply the flexibility available to the MPS to the MFS (Giesberts, 1993). This can be illustrated by some examples. Like the MPS, the MFS is a hierarchical plan: through the techniques of aggregation and disaggregation, it is possible to plan the financial resources and locations at different hierarchical levels. With respect to locations, financial resources can be planned as detailed at the individual locations (e.g. ABN-AMRO, Amsterdam; RABO, Rotterdam; NatWest, London; etc.), but – using aggregation – financial resources can also be planned at a country level, e.g. 'the Netherlands', 'Great Britain'. With respect to financial resources, suppose that different types of mortgaged loans and different types of straight loans were in use. Using aggregation financial resources can then be categorized as 'Mortgage Loans' or 'Straight Loans,' etc.

Like the MPS, the MFS is time-phased (the schedule of financial resources per location is maintained in time periods of a certain length), defined for a period in advance and periodically updated (Fogarty and Hofmann, 1991). There are some specific requirements in the use of the MFS, where a fully centralized treasury management decision-making system has to be supported. First, *all* treasury management *decisions must reflected in the MFS* (because each decision influences the available amount of financial resources per location). The norms defined for each decision must be defined from a centralized perspective; they cannot cover decentralized decision-making situations. Second, the MFS must maintain a *detailed* availability schedule of *all types of financial resources* at *all available locations*. This does not mean that availability at higher levels (as explained in the previous paragraph) cannot be maintained concurrently, but detailed planning is a prerequisite for the centralized approach. Third, the MFS should be *up-to-date at all times*. In comparison to the MPS, which is only updated periodically (often weekly), the centralized treasury management decision-making approach requires a constantly updated MFS. How long in advance the MFS should be updated does not fall within the scope of this text to recommend, as this is situation and sector dependent, though this period should be long enough to support sufficient look-ahead to support the decision. For example, to support surplus investment decisions, it is necessary to plan a certain period in advance to determine whether, and for how long, financial resources are available for the surplus investment. As a result, centralized decision-making requires the inclusion of an additional decision, 'setting the MFS'. The centralized approach model of treasury management decision-making is visualized in Figure 5-3.

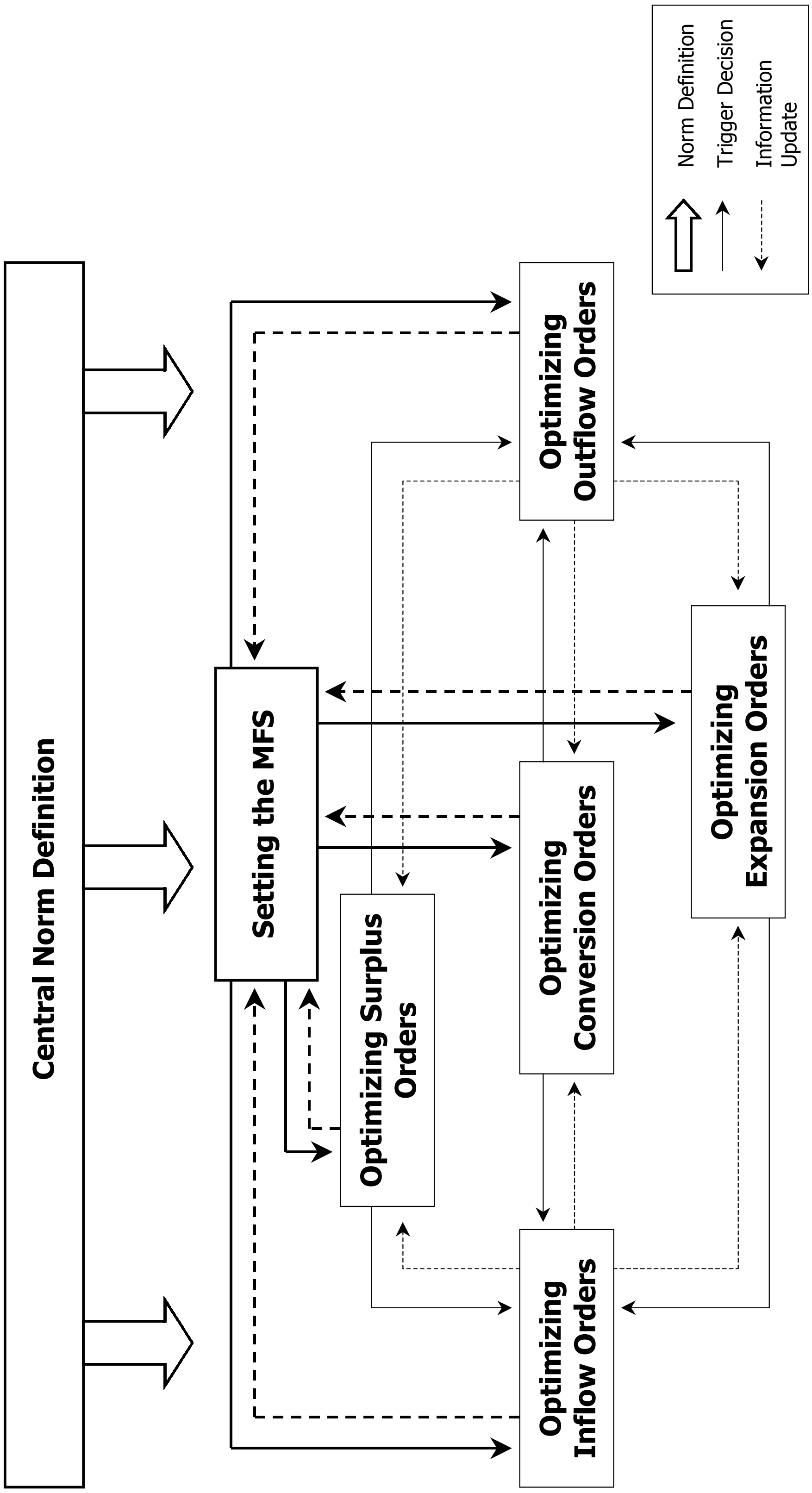

Figure 5-3. Centralized treasury management decision-making

5.4.3 Hybrid treasury management decision-making

The main advantage of the centralized approach over the decentralized approach is the fact that optimizing each decision (and thus optimizing the inventory of financial resources per location) becomes possible across the scope of the entire enterprise instead of being decentralized to a division. However, the centralized system is somewhat artificial, its main prerequisite being the fact that the MFS is continuously updated. In the example above, this implied that if an immaterial, but unplanned outflow or inflow order appears at one of the divisions (in the Rotterdam division, for instance) an update of the MFS is required, maintained in New York, before the order can be accepted. Although this is theoretically possible, it cannot be considered desirable in an efficient system servicing all possible situations. A third system is therefore proposed (called the hybrid approach to treasury management decision-making), in which the advantages of both the centralized and the decentralized approach are combined. The hybrid approach allows some decisions to be made centrally and some decisions decentrally. For example, planned, known financial orders (inflow, outflow, expansion and conversion orders) can be processed *centrally* while unknown orders are processed decentrally. In addition, there are other options to accommodate flexibility. For instance, processing 'material' orders centrally and giving divisions the freedom to decide how to execute 'immaterial' orders. Ultimately, the decision space for each hierarchical level is detailed through norms per decision. Two consequences of the hybrid approach have to be discussed, the functioning of the MFS under the hybrid approach, and how to deal with uncertainty in the supply and demand of financial resources. Because the MFS does not steer all treasury management decisions under the hybrid approach, it does not need to be updated continuously. It would be sufficient to update the MFS weekly or even biweekly depending on the type of business (the MFS would then be updated with both planned and unplanned orders). Depending on the choices made (specifically, which decisions to make centrally and which decisions decentrally), it may even be appropriate to maintain the MFS at a more aggregated level. For instance, financial resources could be scheduled for the Netherlands and Great Britain as two units, rather than detailing financial resources for every location in Amsterdam, Rotterdam and London, were freedom of execution granted at a country level. The hybrid approach, however, presents a new problem, that of uncertainty of demand for financial resources. As a result, financial resources could run out at a location (the RABO in Rotterdam, for example). This problem arises because the MFS does not offer the same degree of financial supply and demand look-ahead as the centralized approach, where all decisions are immediately reflected in the MFS (which is continuously updated), providing full certainty of financial supply and demand. Every demand for and supply of financial resources is scheduled in and processed by the MFS, providing it with a full look-ahead of financial supply and demand.

As it is a characteristic of the hybrid approach that some decisions are immediately reflected in the MFS while other decisions are decentralized, dependent on the norms defined, less information on financial supply and demand is available at the MFS level. Consequently, the MFS does not offer full insight into the supply and demand of financial resources per time period. The previous paragraph also described that the hybrid approach only updates the MFS periodically (and accordingly, decentralized decisions are not immediately updated in the MFS). There are two consequences related to the problem of running out of financial inventory. The first is that it can take some time before financial resources are transferred from another location (this problem is only relative because with modern financing techniques like SWIFT transfers, transfer time can be eliminated). The second consequence is the financial effort (e.g. bank costs) related to resource transfer. This is predominantly the case when financial resources are transferred from abroad. In order to accommodate this situation, a new treasury management decision has to be introduced to the hybrid decision-making system, namely deciding the level of safety stock to be maintained per type of financial resource per location.

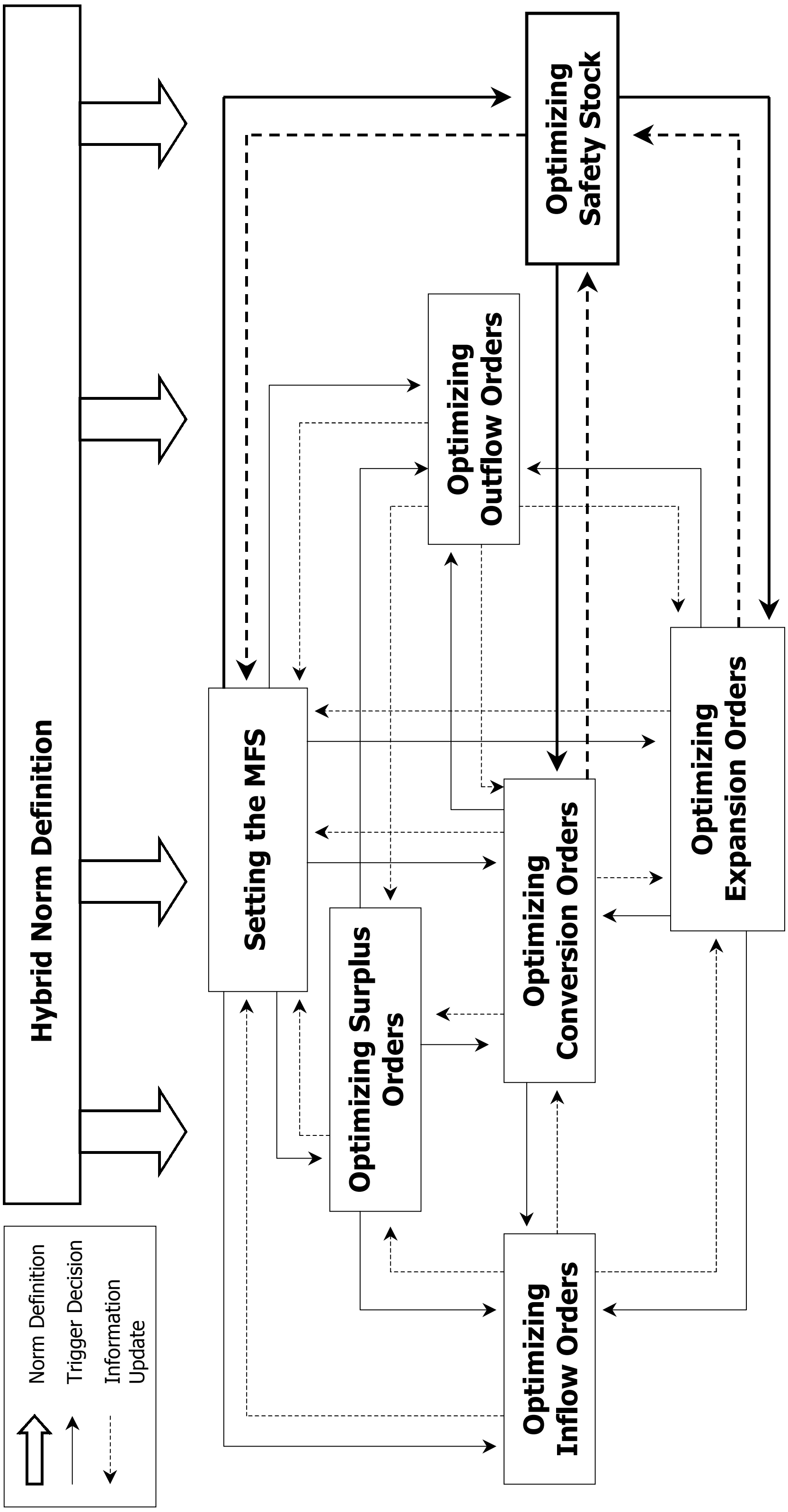

Figure 5-4. Hybrid treasury management decision-making

For locations vulnerable to financial resource shortages due to uncertainty in supply and demand, it is wise to maintain a financial resource safety inventory. The level of the inventory is determined by this decision. It is recognized that some financing techniques already offer a solution to this problem (e.g. 'stand-by' credit is a type of credit that allows financial resources to be used 'when needed' for a relatively small financial effort, e.g. an availability interest rate of 1/16 %). However, the question of '*the quantity of* financial resources to provide with this kind of financing' remains valid and is supported by the 'optimization of the safety stock level per location and per financial resource' decision. The model of the hybrid approach of treasury management decision-making is illustrated in Figure 5-4. Following that, the various relationships between the decisions are discussed in detail.

5.5 The hybrid treasury management decision-making framework explained in detail

This section discusses how the seven short and medium-term treasury management decisions that occur in the hybrid model are related to each other. In the hybrid approach, planned orders are executed centrally by the MFS, while exceptions (unforeseen orders, order potentials) are executed locally. The hybrid treasury management decision model is presented in Figure 5-1. For each of the seven decisions, the following topics are discussed. *1)* A short description of the decision, *2)* examples of norm definitions and *3)* other decisions which are initiated by the decision under discussion. In Table 5-1, an overview of the relationships between treasury management decisions is presented.

Decision A. Setting the Master Financing Schedule

Short Description

The Master Financing Schedule (MFS) is a time-phased plan of the amounts available per financial resource type per location. The decision in the MFS is concerned with the planning of inflows and outflows per financial resource type and the decision on the safety levels available per financial resource type per financial location.

Examples of norm definitions

- Minimum accepted aggregated availability of financial resources
- Investment, conversion, inflow, outflow and expansion instruments to be used
- And so on[31]

Other decisions initiated by this decision

The MFS decision concerns deciding an aggregated plan to be executed later. This is done by initiating the following decisions.

- *Optimizing Financial Resource Inflow Orders*. When the MFS indicates that a financial resource inflow has to take place at a given location within a given period, it initiates the 'Optimizing Financial Resource Inflow Orders' decision to optimize this inflow. Once the inflow order has been executed, the MFS is updated with the new information on the executed inflow order.
- *Optimizing Financial Resource Outflow Orders*. When the MFS indicates that a financial resource outflow has to take place at a given location at a given moment, it initiates the 'Optimizing Financial Resource Outflow Orders' decision to optimize this outflow.

[31] Norms defined at MFS level are valid for the entire MFS plan. It is possible to define specific norms for an individual decision. Under normal circumstances, the norms defined for a specific decision are a further specification of the norms already defined at MFS level.

Table 5-1. Dependencies between treasury management decisions

Treasury management decision	This decision initiates which other Decisions?	This decision is initiated by which other decisions?
a. Setting the Master Financing Schedule	a. Optimizing Financial Resource Inflow Orders b. Optimizing Financial Resource Outflow Orders c. Optimizing Financial Resource Conversion Orders d. Optimizing Financial Resource Expansion Orders e. Optimizing Financial Resource Safety Stock	None
b. Optimizing Financial Resource Inflow Orders	None	a. Setting the Master Financing Schedule b. Optimizing Financial Resource Surplus Orders c. Optimizing Financial Resource Conversion Orders d. Optimizing financial Resource Expansion Orders
c. Optimizing Financial Resource Outflow Orders	None	a. Setting the Master Financing Schedule b. Optimizing Financial Resource Surplus Orders c. Optimizing Financial Resource Conversion Orders d. Optimizing Financial Resource Expansion Orders
d. Optimizing Financial Resource Surplus Orders	a. Optimizing Financial Resource Outflow Orders b. Optimizing Financial Resource Inflow Orders c. Optimizing Financial Resource Conversion Orders	a. Setting the Master Financing Schedule
e. Optimizing Financial Resource Expansion Orders	a. Optimizing Financial Resource Inflow Orders b. Optimizing Financial Resource Outflow Orders c. Optimizing Financial Resource Conversion Orders	a. Setting the Master Financing Schedule
f. Optimizing Financial Resource Conversion Orders	a. Optimizing Financial Resource Inflow Orders b. Optimizing Financial Resource Outflow Orders	a. Setting the Master Financing Schedule b. Optimizing Financial Resource Surplus Orders c. Optimize Financial resource Expansion Orders
g. Optimizing Financial Resource Safety Stock	a. Optimizing Financial Resource Expansion Orders b. Optimizing Financial Resource Conversion Orders	a. Setting the Master Financing Schedule

Once the outflow order has been executed, the MFS is updated with the new information on the executed outflow order.

- *Optimizing Financial Resource Surplus Orders*. When the MFS indicates a surplus of a particular financial resource at a given location at a given moment, it initiates the 'Optimizing Financial Resource Surplus Orders' decision to optimize this surplus. Once the surplus investment has been made (the surplus order has been executed), the MFS is updated with the new information on the executed surplus order.
- *Optimizing Financial Resource Conversion Orders*. When the MFS indicates a deficit of a particular financial resource at a given location, that can be financed by the conversion of a financial resource of which a surplus is available, it initiates the 'Optimizing Financial Resource Conversion Orders' decision. Once the conversion order has been executed, the MFS is updated with the new information on the executed conversion order.
- *Optimizing Financial Resource Expansion Orders*. When the MFS indicates a deficit of a particular financial resource at a given location that cannot be financed by the conversion of a financial resource of which a surplus is available, it initiates the 'Optimizing Financial Resource Expansion Orders' decision. Once the expansion order has been executed, the MFS is updated with the new information on the executed expansion order.
- *Optimizing Financial Resource Safety Stock Levels*. The MFS is the aggregated plan of available financial resources. The availability of financial resources at a given location is influenced by the demand for this financial resource (net balance of inflows and outflows). These inflows and outflows can be planned or unplanned. In order to have financial resources at a given location sufficient also to cover the unplanned part of financial resource demand, the 'Optimizing Financial Resource Safety Stock Levels' decision is initiated. Once this decision has been executed, the MFS is updated with the new information on the required safety stock level per financial resource per location.

This decision is initiated by which other decisions?
This information request concerns deciding the overall availability per financial resource type per location. As such, it is not initiated by other decisions, which fall under the scope of treasury management decisions focusing on optimizing financial resource flows.

Decision B. Optimizing Financial Resource Inflow Orders

Short Description
The decision to optimize financial resource inflow orders concerns ensuring that the amount of financial resources committed flows into the organization optimally at the right moment.

Examples of norm definitions

- Maximum accepted 'financial effort' (e.g. bank cost) per inflow transaction
- Accepted payment instruments (e.g. check, draft, letter of credit, etc.)
- And so on

Other decisions initiated by this decision
There are no other decisions initiated by this decision.

This decision is initiated by which other decisions?
The 'Optimizing Financial Resource Inflow Orders' decision can be initiated by the following decisions.

- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. This plan indicates when a financial resource inflow should take place. In that event, the 'Optimize Financial Resource Inflow Orders' decision is initiated.
- *Optimizing Financial Resource Surplus Orders*. The 'Optimizing Financial Resource Surplus Orders' decision focuses the optimization of surpluses in financial resources. The execution of

this decision comprises an inflow (discussed here) and an outflow part (discussed later in this section). After investment of the surplus of financial resources, they are transferred from the financial participant (organizing the investment) with compensation for the organization. This inflow can be optimized by executing the 'Optimizing Financial Resource Inflow Orders' decision.
- *Optimizing Financial Resource Conversion Orders*. The 'Optimizing Financial Resource Conversion Orders' decision focuses the optimization of financing a deficit in a financial resource through the conversion of a surplus financial resource. The execution of this decision involves an inflow (discussed here) and an outflow part (discussed later in this section). Once the conversion has taken place, a new amount of financial resources is available (namely, the 'converted' amount), to be returned by the financial participant (organizing the conversion) to the organization (deducted with compensation). This inflow can be optimized by executing the 'Optimizing Financial Resource Inflow Orders' decision.
- *Optimizing Financial Resource Expansion Orders*. The 'Optimizing Financial Resource Expansion Orders' decision focuses the optimization of the expansion of financial resources. The execution of this decision concerns an inflow (discussed here) and an outflow part (discussed later in this section). Once the acquisition of a new amount of financial resources has been decided upon, they flow from the financial participant offering the new financial resources into the organization. This inflow can be optimized by executing the 'Optimizing Financial Resource Inflow Orders' decision.

Once the inflow order has been executed, the MFS, the Financial Resource Surplus Order, the Financial Resource Conversion Order, or the Financial Resource Expansion Order are respectively updated with the actual information on the inflow order (e.g. what was the exact inflow amount? when did the inflow take place? etc.).

Decision C. Optimizing Financial Resource Outflow Orders

Short Description
The decision to optimize financial resource outflow orders involves ensuring that the amount of financial resources committed flows optimally out of the organization at the right moment.

Examples of norm definitions
- Maximum accepted 'financial effort' per outflow transaction
- Payment instruments accepted (e.g. cheque, draft, trade note, etc.)
- And so on

Other decisions initiated by this decision
There are no other decisions initiated by this decision.

This Decision is initiated by which other decisions?
The 'Optimizing Financial Resource Outflow Orders' decision can be initiated by the following decisions.
- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. This plan indicates when a financial resource outflow should take place. In the event, the 'Optimize Financial Resource Outflow Orders' decision is initiated.
- *Optimizing Financial Resource Surplus Orders*. The 'Optimizing Financial Resource Surplus Orders' decision focuses the optimization of surpluses in financial resources. The execution of this decision involves an outflow (discussed here) and an inflow part (discussed earlier in this section). When a surplus needs to be invested, it first has to be transferred to the financial participant organizing the investment. This outflow can be optimized by initiating the 'Optimizing Financial Resource Outflow Orders' decision.
- *Optimizing Financial Resource Conversion Orders*. The 'Optimizing Financial Resource Conversion Orders' decision focuses the optimization of deficit financing through the

conversion of a financial resource surplus. The execution of this decision involves an outflow (discussed here) and an inflow part (discussed earlier in this section). First, the financial resources to be converted have to be transferred to the financial participant organizing this conversion. This outflow can be optimized by initiating the 'Optimizing Financial Resource Outflow Orders' decision.
- *Optimizing Financial Resource Expansion Orders*. The 'Optimizing Financial Resource Expansion Orders' decision focuses the optimization of the expansion of financial resources. The execution of this decision involves an outflow (discussed here) and an inflow part (discussed earlier in this section). At the end of an expansion agreement, financial resources have to flow back to the financial participant (offering the financial resources) with compensation. This outflow can be optimized by executing the 'Optimizing Financial Resource Outflow Orders' decision.

Once the outflow order has been executed, the MFS, the Financial Resource Surplus Order, the Financial Resource Conversion Order or the Financial Resource Expansion Order are respectively updated with the actual information on the outflow order (e.g. what the exact outflow amount was, when the outflow took place, etc.)

Decision D. Optimizing Financial Resource Surplus Orders

Short Description
The decision to optimize financial resource surplus orders concerns temporary surpluses of invested financial resources.

Examples of norm definitions
- Maximum accepted 'financial effort' (e.g. bank cost) per surplus transaction
- Minimum amount invested per surplus order
- Minimum required 'financial bonus' (compensation received) per surplus transaction
- Investment instruments accepted (savings, investment in shares or bonds use of option contracts, etc.)
- And so on

Other decisions initiated by this decision
The 'Optimizing Surplus Orders of Financial Resources' decision can initiate the following decisions.
- *Optimizing Financial Resource Outflow Orders*. Once investing surplus financial resources at a particular location has been decided upon, it has then to be decided how the outflow to the participant taking care of the investment is to take place. This outflow is optimized by executing the 'Optimizing Financial Resource Outflow Orders' decision.
- *Optimizing Financial Resource Inflow Orders*. When the financial resources invested return to the organization (with compensation), it has to be decided how this inflow will take place. This inflow is optimized by executing the 'Optimizing Financial Resource Inflow Orders' decision.
- *Optimizing Financial Resource Conversion Orders*. When a financial resource conversion order optimizes financial resources (in surplus) to be converted into other financial resources (required), an alternative outcome of the 'Optimize Financial Resource Surplus Orders' decision is to make the financial resources available for conversion.

Once these decisions have been executed, the surplus order is updated with the actual information on the exact amount that flowed in or out of the organization, the exact timing etc.

This Decision is initiated by which other decisions?
The 'Optimizing Surplus Orders of Financial Resources' decision can be initiated by the following decision.

- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. This plan indicates when a surplus of a certain financial resource is available at a given location. In the event, the 'Optimize Financial Resource Surplus Orders' decision is initiated.

After a surplus order is executed, the MFS is updated with the actual data on the amount invested, the compensation received, timing, etc.

Decision E. Optimizing Financial Resource Conversion Orders

Short Description

The decision to optimize financial resource conversion orders concerns the financing of temporary deficits in financial resources through the conversion of surplus financial resources.

Examples of norm definitions

- Maximum accepted 'financial effort' per conversion transaction
- Minimum amount to convert per conversion order, conversion instruments accepted (e.g. use of option contracts, forward rate agreements, etc.)
- And so on.

Other decisions initiated by this decision

The 'Optimizing Conversion Orders to finance Deficits of Financial Resources' decision can be initiated by the following decisions:

- *Optimizing Financial Resource Inflow Outflow Orders*. Once financing a deficit of financial resources at a particular location by conversion of a surplus financial resource has been decided upon, how the outflow to the financial participant take care of the conversion is to take place has then to be decided. This is achieved by executing the 'Optimizing Outflow Orders of Financial Resources' decision.
- *Optimizing Financial Resource Inflow Orders*. Once the surplus financial resources have been converted, the new (converted) financial resources have to be transferred from the financial participant organizing the conversion back to the organization.

The information returned is an update of the conversion order with the actual amount of financial resources (with the 'financial effort' to be offered for the conversion deducted) flown in or out of the organization.

This decision is initiated by which other decisions?

The 'Optimizing Financial Resource Conversion Orders' decision can be initiated by the following decisions.

- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. This plan indicates when a deficit occurs in a given financial resource at a given location. If this deficit can be financed through the conversion of a surplus financial resource, the 'Optimize Financial Resource Conversion Orders' decision is initiated.
- *Optimizing financial resource surplus orders.* The 'Optimizing Financial Resource Surplus Orders' decision outlines the different alternatives for optimizing a surplus. One of the alternatives is converting the financial resource into a financial resource of which there is shortage. In this case, the 'Optimizing Financial Resource Conversion Orders' decision is initiated.
- *Optimizing financial resource expansion orders.* The 'Optimizing Financial Resource Expansion Orders' decision outlines the different alternatives in financing a deficit. One of the alternatives is financing by converting a surplus financial resource, in which case, the 'Optimizing Financial Resource Conversion Orders' decision is initiated.

The information returned is the update of the MFS with data on the conversion order executed (e.g. an addition of the amount of the financial resource converted and a deduction from the financial resource type from which it was converted).

Decision F. Optimizing Financial Resource Expansion Orders

Short Description
The objective of the 'Optimizing Financial Resource Expansion Orders' decision is to increase the available amount of a type of financial resource at a given location in order to cope with short-term fluctuations in the demand for financial resources.

Examples of norm definitions
- Maximum accepted 'financial effort' (e.g. bank cost, interest cost) per expansion transaction
- Types of financial resources accepted as expansion
- And so on

Other decisions initiated by this decision
The 'Optimize Expansion Orders to finance Deficits of Financial Resources' decision can initiate the following decisions.
- *Optimizing Financial Resource Inflow Orders*. Once the new (acquired) financial resources have entered the organization, how this inflow is to take place has to be decided.
- *Optimizing Financial Resource Outflow Orders*. When the financial resources acquired have to be returned to the financial participant (with eventual compensation), how the outflow to the participant taking care of the financing is to take place has to be decided upon.
- *Optimizing Financial Resource Conversion Order*. When new financial resources are required, one option is to convert other available financial resources into surplus.

The information returned is the update of the expansion order with the amount of financial resources flown into or out of the organization.

This decision is initiated by which other decisions?
The 'Optimize Expansion Orders to finance Deficits of Financial Resources' decision is initiated by the following decision.
- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. This plan indicates when a deficit occurs in a particular financial resource at a given location. If this deficit cannot be financed through the conversion of a surplus financial resource, the 'Optimize Financial Resource Expansion Orders' decision is initiated.

The information returned is the update of the MFS with the data on the expansion order executed (e.g. addition of amount obtained).

Decision G. Optimizing Financial Resource Safety Stock Level

Short Description
The objective of the 'Optimizing Financial Resource Safety Stock Level' decision is to determine the amount of available financial resource inventory, to allow for uncertainty in supply and demand of financial resources in the short run.

Examples of norm definitions
Minimum level of 'financial service level[32]' guaranteed.

Other decisions initiated by this decision
The 'Optimizing Financial Resource Safety Stock Levels' decision can initiate the following decisions.

[32] In this context, 'financial service level' is defined as the ability to satisfactorily service financial resource demand.

- *Optimizing Financial Resource Expansion Orders.* When a safety stock is required at a particular location, new financial resources can be acquired at this location by initiating the 'Optimizing Financial Resource Expansion Orders' decision.
- *Optimizing Financial Resource Conversion Orders.* When a safety stock is required at a particular location, converting an amount of surplus financial resources is an option. This can be done by initiating the 'Optimizing Financial Resource Conversion Orders' decision.

This decision is initiated by which other decisions?
The 'Optimizing Financial Resource Safety Stock Level' is initiated by the following decision.

- *Setting the MFS*. The MFS is a time-phased, aggregated plan per financial resource type per location. The level of available financial resources is influenced by the net demand for financial resources (a balance of inflows and outflows). Due to the characteristics of the organization and ultimately to seasonal patterns, this demand can be unpredictable, resulting in unpredicted shortages. The 'Optimize Financial Resource Safety Stock Levels' decision can be initiated to determine a safety level of available financial resources resulting in fewer and more predictable shortages of financial resources per location.

The information returned is the update of the MFS with the level of safety stock financial resources per type and per location.

5.6 Summary

An application for validating whether the contract data model can hold sufficient data was outlined in this chapter, chosen to be in the domain of treasury management. Based on the criterion of the scope of data that can be held by the contract model (i.e. data where the organization was one of the contracting parties, see Section 2.6.2 of Chapter 2), it was chosen to define the application scope for validation as 'treasury management decisions focusing on financial resource optimization flows'. Since different types of data were required in addition to the contract data type for treasury management decision-making for risk optimization, this area was left out of scope.

The hierarchical approach to decision-making in the domain of business logistics has already been used in practice for several decades. It originated as direct result of the need to solve the drawbacks related to statistical methods, like forecasting to determine the inventory level. The solution was found through detailed product order planning and providing a multi-level decision-making approach where constraints defined at a higher level are also effective for lower-level decisions. Financial resource flows resulting from treasury management decisions are often compared to operational resource flows. However, a comparison between proceedings in these two disciplines has indicated that the concept of hierarchical decision-making has not yet been adopted in treasury management. In this chapter, a framework effective in servicing hierarchical decision-making has been proposed. Three different frameworks were presented, one for decentralized decision-making, one for centralized decision-making and one that allows optimization between centralized and decentralized decision-making depending on the situation (called the hybrid decision-making framework). This latter framework was offered as the framework best capable of supporting hierarchical treasury management decisions in practice. Two new decisions were introduced, namely setting the Master Financing Schedule and optimizing the safety stock level per financial resource type and location. What information is required to support these decisions with financial data will be investigated in the next chapter.