Accounting information for changing business needs

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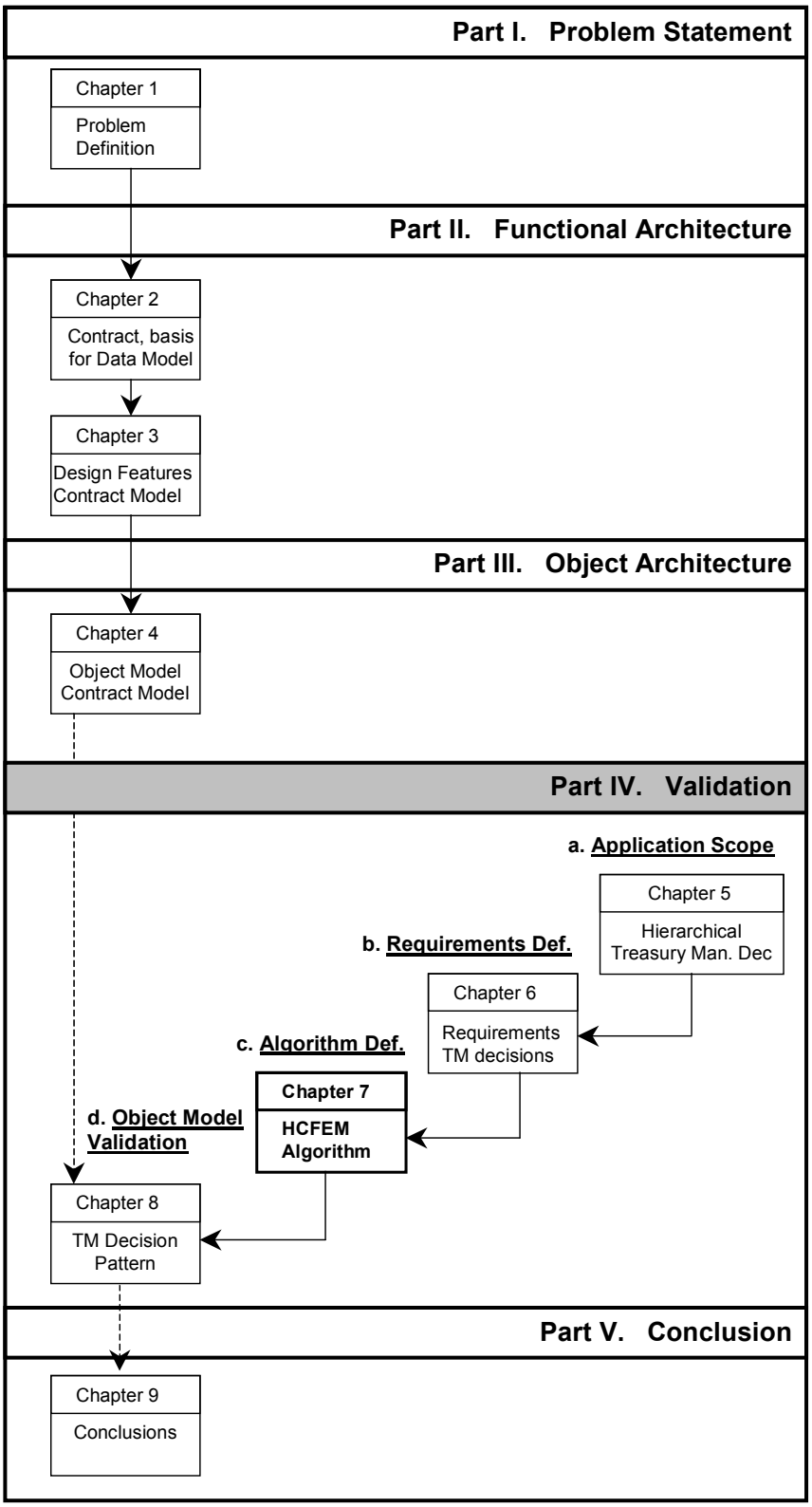
Part IV: Validation

c. Algorithm Definition


Part I. Problem Statement
Chapter 1
Problem Definition
Part II. Functional Architecture
Chapter 2
Contract, basis for Data Model
Chapter 3
Design Features Contract Model
Part III. Object Architecture
Chapter 4
Object Model Contract Model
Part IV. Validation
a. Application Scope
Chapter 5
Hierarchical Treasury Man. Dec
b. Requirements Def.
Chapter 6
Requirements TM decisions
c. Algorithm Def.
Chapter 7
HCFEM Algorithm
d. Object Model Validation
Chapter 8
TM Decision Pattern
Part V. Conclusion
Chapter 9
Conclusions

7. Algorithm to support Treasury Management Decisions with Relevant Costs

7.1 Introduction

This chapter describes the generic algorithm to be used to support treasury management decisions as defined in Section 5.5 of Chapter 5 with *ex ante* and *ex post* accounting information as discussed in Section 6.3 of Chapter 6. Since principles of business logistics were applied to outline the hierarchical treasury management decision frameworks in Chapter 5, this discipline's principles will also be used in this chapter to define an algorithm to calculate the outcome of any decision scenario generically. This chapter concludes with a summary of the additional requirements for data availability required to support the proposed common algorithm, and is intended as a solution to research question three of research objective two as outlined in Section 1.4 of Chapter 1.

Research Objective 2, Research Question 3: How a consistent process be outlined to define relevant costs in such a way that an information system can determine incremental and opportunity costs for any treasury management decision scenario?

The chapter is structured as follows. First, in Section 7.2, the MRP netting algorithm will be proposed as the algorithm to be reused in the domain of treasury management to optimise the use of financial resources. Section 7.3 goes on to provide some definitions and an overview of the relevant financial resource flows within manufacturing organizations, expressed in the design features of the contract data model. Subsequently, Section 7.4 applies the principles of MRP netting to financial resource flows to express the supply-side and demand-side effects of changes in financial resource demand, resulting in the HCFEM. Next, a generic calculation framework is presented to service treasury management decisions with relevant costs in Section 7.5, and then the HCFEM is illustrated in Section 7.6 by an example. Finally, in Section 7.7, a statement of data requirements to support the HCFEM algorithm is presented and this chapter is summarised in Section 7.8.

7.2 In search of a suitable algorithm for hierarchical treasury management decision-making

The object of introducing the treasury management application in this research (started in Chapter 5) is to validate whether the contract data model as proposed in Chapters 2, 3 and 4 can hold sufficient data to support a representative new application. This validation started by first outlining the scope of the new application (the treasury management decision framework, see Chapter 5). Later, in Chapter 6, the requirements for data availability for treasury management decisions supported with relevant costs was investigated. This chapter investigates the existence of possible additional requirements on data availability when proposing the application logic of the algorithm used in calculating the outcome of any treasury management decision alternative with relevant costs generically.

In order to investigate to what extent the contract data model can hold data and which additional requirements on data availability have to be defined, the algorithm for treasury management decision-making will be defined as a relationship between the contract types used (see Section 7.4). Section 2.5 explained that the act of defining and recording business process instance data in contracts is called 'contract-based accounting'. The way the

algorithm will be described can be considered as an application of 'contract-based accounting'. It should be noted that the ultimate goal of the validation is to verify whether the contract data model can hold sufficient data. The notation of the algorithm in terms of contract type relations only facilitates the attainment of this goal.

This section will determine which business logistics algorithm will be reused in the domain of treasury management to allow financial resource optimization based on relevant cost calculations. This algorithm will operate in the context of hierarchical decision-making, where decisions made at a lower level take into consideration the outcomes of decisions made at a higher level.

Improved business logistics algorithms were proposed when it was demonstrated that traditional inventory models like EOQ (Camp, 1922) provided inaccurate information to service material and labour capacity planning processes. Initially, improvements were made specifically to inventory models (see e.g. Buchan and Koenigsberg, 1963; Wagner, 1962), until researchers found that accurate data could only be obtained when focusing on detailed planning of the logistics processes themselves (Orliky, 1975). The Material Requirements Planning (MRP-I) and Manufacturing Resource Planning (MRP-II) processes were defined as a result (see e.g. Forgarty et al., 1991; Wight, 1982). Studies focusing on operational resource capacity optimization include Balakrishnan and Sivaramakrishnan (1996) and O'Brian and Sivaramakrishnam (1996), but they have not been applied outside business logistics. Few research initiatives can be found on the topic in the field of 'financial logistics'. Swagerman and Wassenaar (1998) and Swagerman (2000) describe how to organize and execute financial logistics applications within and between organizations. In Chapter 5 of this dissertation, a framework for hierarchical treasury management decision-making based on business logistics principles was described.

In this chapter, the MRP (Material Requirements Planning) netting algorithm will be applied as defined in the domain of business logistics to service the hierarchical framework of treasury management decisions (see Chapter 5, Section 5.5) with relevant costs (for requirements, see Chapter 6, Section 6.3). This model will be presented as the Hierarchical Cash Flow Equivalent Model (HCFEM). It is the explicit objective here that this algorithm will be able to be implemented in information systems. Therefore, it is expressed in contract data model design features terms (see Sections 3.2 and 3.3 of Chapter 3). Verdaasdonk (1998) defined a similar model (the Hierarchical Cash Flow Model, HCFM) focusing on determining the relevant costs (incremental and opportunity effects) of business logistics decisions. The HCFEM can be regarded as an application of the HCFM in the domain of treasury management decisions.

7.3 Definitions

The following items have to be defined prior to the description of the HCFEM. *1)* A reference model of financial resource flows in the manufacturing organization, *2)* an indication of financial resource flow directions and *3)* the MRP netting reservation logic to be applied in HCFEM.

7.3.1 Relevant financial resource flows within manufacturing organizations

A reference framework of financial resource flows within manufacturing organizations is required to have a finite number of possible financial resource flow types available to be

incorporated in the HCFEM algorithm (see next section)[43]. The contract data model is a data model allowing business process instance data to be recorded, which overcomes some of the disadvantages of double-entry bookkeeping (see Section 2.5 of Chapter 2). In the contract data model, a resource exchange is defined in a contract clause (see Section 3.2.1 of Chapter 3). Apart from this, the activity of creating and using contracts in the organization is called 'contract-based accounting'. This approach is applied here to define the various contexts in which financial resource flows can occur in manufacturing organizations with a view to defining the HCFEM as an application of contract-based accounting.

The objective of manufacturing organizations is to be profitable by offering products or services to participants in the sales market. These products are manufactured by the organization itself or obtained in the procurement market. Operational resources are compensated for by financial resources (case 1). Under some specific circumstances, the organization can experience a surplus or a deficit in financial resource availability. In the event that this occurs, it can go to the financial market either to invest the surplus or to finance the deficit (case 2). A deficit of financial resources being covered through the conversion of other, surplus financial resources is a special instance of the latter case (case 3)[44].

Case 1: Operational supply and demand contract clauses
The exchange of operational resources for financial resources can occur in two specific situations. The first relates to an incoming operational resource flow from a procurement market in exchange for outgoing financial resources, i.e. products or services procured from suppliers to whom financial resources are paid as compensation. From the viewpoint of procurement market participants, these contract clauses are called *operational supply contract clauses*. The second relates to an outgoing operational resource flow to participants in the sales market, for which financial resources are received in exchange, i.e. products are sold or services offered to customers from whom financial resources are received in compensation. From the perspective of participants in the sales market, these contract clauses are called *operational demand contract clauses*. This is illustrated in Figure 7-1.

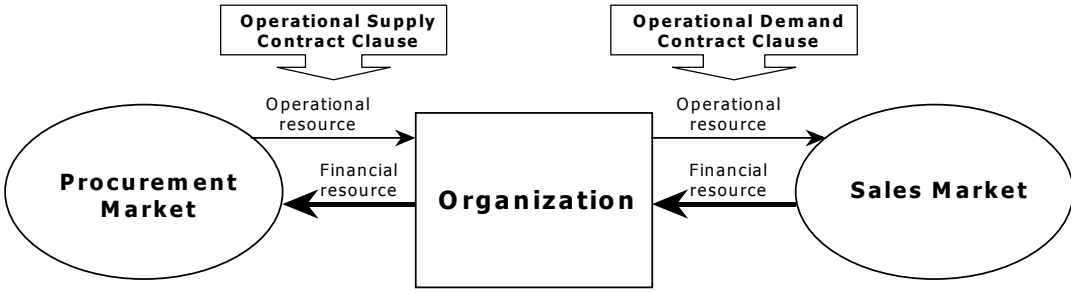


Figure 7-1. Operational supply and demand contract clauses in a manufacturing organization (modified from Verdaasdonk, 1998, p. 51)

[43] For a comparable analysis of operational resource flow types in manufacturing organizations, see Verdaasdonk (1998, pp. 50-55).
[44] For reasons of simplicity, the discussion here is limited to the three main contract clause types. It is understood that in real-life circumstances, many more types, including salary contract clause, corporate tax, social and environmental tax, etc., can be found.

Case 2: Financial supply and demand contract clauses
The exchange of two financial resources can also be envisaged from two viewpoints. From the perspective of participants in the financial market, the contract clause that refers to an outgoing financial resource, later settled by an incoming financial resource plus compensation, is referred to as a *financial supply contract clause* (e.g. a loan granted to an organization to finance a deficit). When the contract refers to an incoming financial resource flow later settled by an outgoing financial resource flow, it is termed a *financial demand contract clause* (i.e. the organization invests a surplus). The financial supply and demand contract clauses are depicted in Figure 7-2.

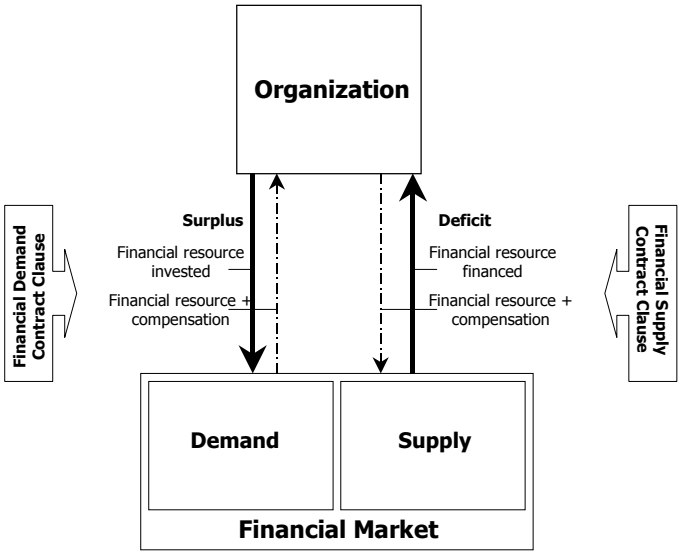


Figure 7-2. Financial supply and demand contract clauses in a manufacturing organization

Case 3: Financial conversion contract clauses
In the third and last case (conversion of one financial resource into another financial resource), the contract clause detailing this conversion is referred to as a *financial conversion contract clause*. This contract clause can be described from two viewpoints. From a financial market perspective, the viewpoint that refers to an incoming financial resource flow that is to be converted is called a *financial conversion demand contract clause* viewpoint (i.e. the organization offers financial resources for conversion). The viewpoint of the financial conversion contract clause describing the outgoing converted financial resource flow is called the *financial conversion supply contract clause* viewpoint. It should be stressed that these two viewpoints together detail one and the same financial conversion contract clause. This can be illustrated by an example. EUR 1,000 (the financial resource available) is to be converted into USD 950 (the financial resource required). The financial conversion supply contract clause viewpoint focuses on the supply of USD 950, while the financial conversion demand contract clause viewpoint focuses on the demand for EUR 1,000. Figure 7-3 illustrates the financial conversion contracts clause.

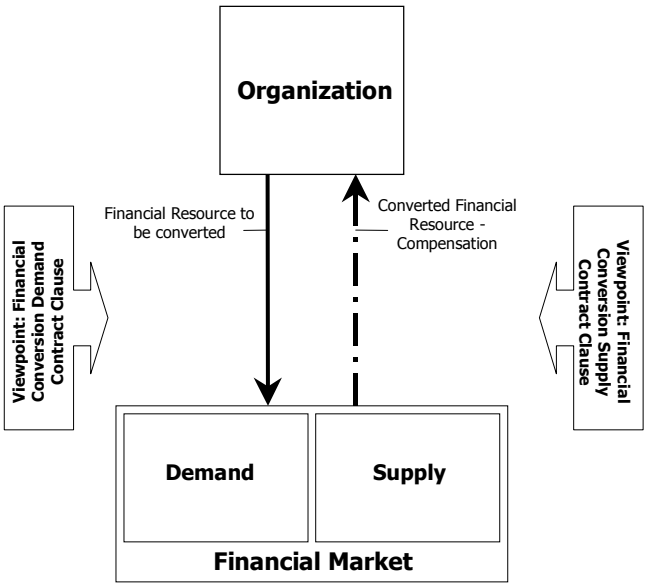


Figure 7-3. Financial conversion supply and demand contract clauses in a manufacturing organization

7.3.2 Indication of financial resource flow direction

In the contract data model, contracting participants *can* have a dual relationship that corresponds with either the contract clause *party* or contract clause *opposing party* role (see Section 3.2.2 of Chapter 3). With regard to financial resource flows, the roles that can be associated to 'party' or 'opposing party' correspond to the *give* or *take* relationship as explained by Geerts and McCarthy (1997). In order to indicate the direction of the financial resource flow, a viewpoint has to be assigned to the give and take relationship. It was chosen to define the *give* or *take* relationship from the viewpoint of the external participants by convention. Applied to the direction of financial resource flows, this implies that a *give* relationship refers to an *incoming* financial resource flow (e.g. an external participant 'customer' *gives* financial resources in compensation for products received). The *take* relationship refers to an *outgoing* financial resource flow (e.g. an external participant 'supplier' *takes* financial resources from the organization as compensation for delivered products). The give and take relationships in financial resources in the different contract clause types are defined in Table 7-1.

7.3.3 MRP Netting Reservation Logic

When calculating the plan for financial resource availability, two situations can be discerned. First, contract clauses detailing financial resource flows are available and known at the moment of planning. Financial resource amounts disclosed by these contract clauses are adopted in the plan. Second, contract clauses detailing financial resource flows are not yet known at the moment of planning. This latter type relates to the possibility that a contract clause (which is not defined at the moment when the planning process is initiated) will become available at some time in the future.

Table 7-1. Give and take relationships of financial resources in different types of contracts

Contract Clause Type	Give- or Take relationship of Financial Resource[45]
1. Operational Supply Contract Clause	Take relationship in financial resource offered in exchange (e.g. payment to a supplier)
2. Operational Demand Contract Clause	Give relationship in financial resource offered in exchange (e.g. collection from a customer)
3. Financial Supply Contract Clause	Give relationship in deficit financial resource offered in exchange (e.g. receipt of bank loan)
4. Financial Demand Contract Clause	Take relationship in surplus financial resource offered in exchange (e.g. surplus investment)
5. Financial Conversion Supply Contract Clause	Give relationship in converted financial resource (e.g. converted resources used for deficit financing)
6. Financial Conversion Demand Contract Clause	Take relationship in financial resource offered for conversion (e.g. resources offered for conversion to the bank)

Verdaasdonk (1998, p. 53) defines this type of contract clause as '*contract* [clause] *potentials*'. This term is also used in this dissertation. A reservation mechanism has to be applied to indicate with different levels of certainty whether financial resources are available and whether the destination of financial resources can be changed or not. The Material Requirements Planning (MRP) netting algorithm known in business logistics contains a reservation mechanism, reused here, with different planning states. The following reservation states are applied for contract clauses and contract clause potentials: 'planned' and 'final'. For clauses in the 'planned' state, the destination of financial resources has already been defined but can be changed. The destination of financial resources detailed in clauses in the 'final' reservation state are frozen and cannot be changed further.

7.4 Determining the real impact of the treasury management decision: financial resource flows[46]

7.4.1 Introduction

This section will describe the algorithm to determine the real impact of treasury management decisions. As explained earlier in Section 7.2, the ultimate goal is to investigate whether the algorithm supporting treasury management decisions with relevant costs generically (as described in this section and in Section 7.5) creates additional requirements for data availability when supporting this algorithm through the data defined in the contract data model[47]. The additional requirements for data availability are described in Section 7.7 and will be used along with the data requirements for treasury management decisions (Section 6.4) to validate whether the contract data model can hold sufficient data (see Chapter 8).

[45] Defined from the perspective of the external participants.

[46] Verdaasdonk (1998, pp. 56-69) has presented the HCFM (Hierarchical Cash Flow Model), which is a comparable analysis for determining the physical *operational* resource flows which are the real effect of Business logistics decisions.

[47] The initial set of data availability requirements related to the treasury management decisions supported with relevant costs, and was described in Chapter 6, Section 6.4.

In order to define how this algorithm is to utilize data stored in the contract data model, the algorithm has been redefined in terms of relationships between types of contracts (an example of 'contract-based accounting', see Section 2.5 of Chapter 2). The objective of this approach is to investigate which data are missing (defined as additional data requirement for data availability, see Section 7.7). The definition of the algorithm in terms of the relationship between contract types is a means to attain this goal.

The HCFEM is a generic algorithm that services treasury management decisions at different levels with relevant cost information. The outcome on lower level decisions is calculated while adopting limitations set by higher level decisions as input parameters. Lower level decisions can deviate from higher level decisions. However, in such situations the financial plan has to be recalculated entirely. The HCFEM is capable of processing all treasury management decisions as described in Section 5.5 of Chapter 5[48] using the same algorithm in 4 consecutive steps.

- Step 1: Identification of new demand for financial resources
- Step 2: Compensating the new demand for financial resources
- Step 3: Processing the financial resource supply-side effect of the financial resource plan (i.e. the possible future supply of financial resources)
- Step 4: Processing the financial resource demand-side effect of the financial resource plan (i.e. the other possible demand for financial resources).

This is presented in Figure 7-4.

7.4.2 Step 1: Identification of new demand for financial resources

The first step in the HCFEM is the definition of new demand for financial resources. The possible sources of new demand for financial resources are derived from the various possible contract clauses with financial resource consequences in a manufacturing organization as discussed in Section 7.2. The demand for financial resources can be expressed by any combination of the following contract clause types.

- Take relationship in a new operational supply contract clause (final or planned), e.g. supplier invoices to be paid
- Take relationship in a new financial demand contract clause (final or planned), e.g. interest to be paid on loans

Take relationship in a new financial conversion demand contract clause (final or planned), e.g. amounts to be converted.

7.4.3 Step 2: Solving the new demand for financial resources

When there is a new demand for financial resources, the second step involves the evaluation of whether the demand can be fulfilled on the basis of available financial resources (e.g. money available in a bank account, available credit lines, etc.). Where possible, this is always the preferred option.

[48] The following treasury management decisions are distinguished. *1)* Setting the Master Financing Schedule, *2)* Optimizing Financial Resource Outflow Orders, *3)* Optimizing Financial Resource Inflow Orders, *4)* Optimizing Financial Resource Surplus Orders, *5)* Optimizing Financial Resource Expansion Orders, and *6)* Optimizing Financial Resource Expansion Orders.

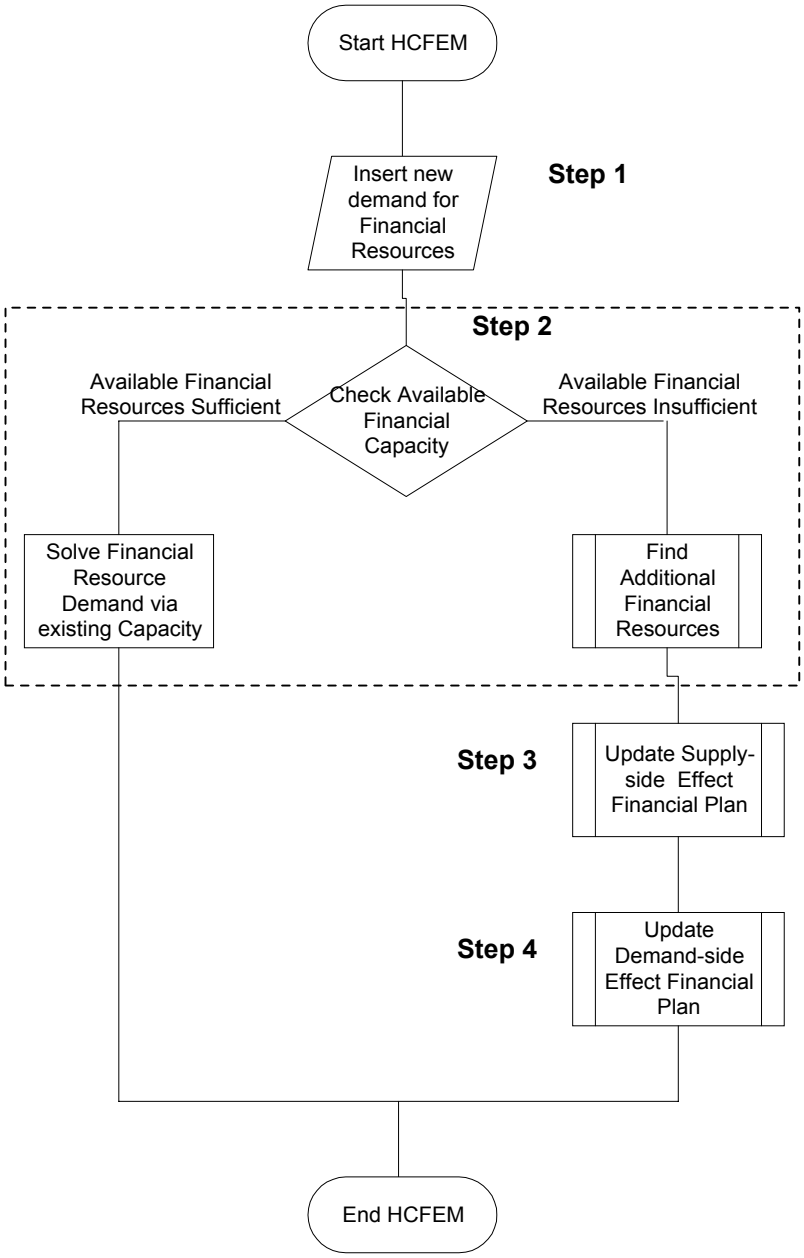


Figure 7-4. Overview of the various steps in the hierarchical cash flow equivalent model

If no sufficient financial resources are available, the financial resource demand is compensated by any combination of the following possibilities.

- Give relationship in an operational demand contract clause (final, planned or potential), e.g. new customer receipts
- Give relationship in a financial supply contract clause (final, planned or potential), e.g. new bank loans
- Give relationship in a financial conversion supply contract clause (final, planned or potential), e.g. new converted financial resources.

Each option is discussed below.

Financial resource demand fulfilled by an operational demand contract clause
Financial resources defined in an operational demand contract clause relate to where a customer offers a certain amount of financial resources as compensation for the delivery of products or services. The operational demand contract clause can either be 'committed' or 'projected', or can relate to a 'potential' new contract clause. The consequences are different in each of the three possible cases.

A 'committed' operational demand contract clause relates to the certainty that the customer will 'give' the financial resources. Two possible reservation states can be applied, 'final' and 'planned'. Committed operational demand contract clauses at the 'final' reservation state are concerned with the case where the financial resources already have a fixed destination and cannot be used to service the new financial resource demand. Possible fixed destinations include a committed operational supply contract clause (e.g. payment of supplier invoices), a committed financial demand contract clause (e.g. repayment of loans, interest payment, etc.) or a committed financial conversion demand contract clause (e.g. committed quantity of financial resources to be given in exchange for the conversion). In the situation where the committed operational demand contract clause is at the 'planned' reservation state, the original destination was not yet fixed and can be changed to compensate a new demand for financial resources.

Where operational demand contract clauses are 'projected', there is an expectation (but no firm certainty) that the customer will 'give' the financial resources. The 'final' and 'planned' reservation states can be used. Projected operational demand contract clauses at the 'final' reservation state are used when, for instance, there is a projected sale of products or services. The financial resources to be received in exchange are already allocated to fulfil a specific financial demand though there is no detail of the sales transaction date as yet. The financial resources will be received at a future point but their timing and location are not yet known. As these financial resources are at the 'final' reservation state, they cannot be considered as having fulfilled a new financial resource demand. Projected operational demand contract clauses for which financial resources given in exchange are at the 'planned' reservation state can be used to fulfil a new financial resource demand. Examples of these are a not yet detailed sales contract clause implying that a certain amount of financial resources will be received over the coming year, though timing, financial resource type and location are not yet detailed.

Operational demand contract clause potentials relate to new unplanned operational demand contract clauses. Financial resources received in exchange as detailed in this new operational demand contract clause can be reserved to service the new financial resource demand. The 'final' or 'planned' reservation states will be allocated depending on the nature of the financial resource demand.

Financial resource demand fulfilled via a financial supply contract clause
Financial resources offered through a financial supply contract clause concern an opposing financial party (e.g. a bank) who provides an amount of financial resources (e.g. a new loan) in exchange for another amount of financial resources (e.g. loan + interest). The financial supply contract clause can either be 'committed' or 'projected', or it can relate to a 'potential' new contract clause. The consequences are different in each of the three cases.

For 'committed' financial supply contract clauses, there is certainty that the opposing financial party will 'give' the financial resources. Two possible reservation states are applicable, 'final' and 'planned'. For the 'final' reservation state, the financial resources already have a fixed destination and cannot be used to service the new financial resource demand. The same fixed destinations as discussed for 'final' committed operational demand contracts also apply here. When the committed financial supply contract clause is at the 'planned' reservation state, then the original destination was not fixed and can be changed to fulfil a new demand for financial resources.

For ‘projected’ financial supply contract clauses, the opposing financial party is expected to ‘give’ the financial resources, but no firm certainty has been obtained. Possible reservation states are ‘final’ and ‘planned’. Projected financial supply contract clauses at the ‘final’ reservation state are used, for instance, in the event of a projected bank loan. The financial resources to be obtained are already allocated to fulfil a specific financial demand but there is no specification when the bank loan will be received. Over time, the financial resources will be provided, but specifications on timing and location are not yet known. As these financial resources are at the ‘final’ reservation state, they may not be taken into account to fulfil a new financial resource demand. Projected financial supply contract clauses can be used to fulfil a new financial resource demand, when the financial resources offered in exchange are at the ‘planned’ reservation state. Examples of these are a not yet detailed credit line contract clause implying that a certain amount of financial resources will be received over the coming year, though timing, financial resource type and location are not yet detailed.

For a ‘potential’ financial supply contract clause, there is a new unplanned financial supply contract clause insertion. Financial resources obtained by this new financial supply contract clause can be reserved to service the new financial resource demand, and receive a reservation state (i.e. ‘final’ or ‘planned’) on the basis of the specifications of the financial resource demand.

Financial resource demand fulfilled by a financial conversion supply contract clause

Financial resources specified in a financial conversion supply contract clause indicate that an amount of financial resources of one type is obtained in exchange for an amount of financial resources of another type. The financial conversion supply contract clause can either be ‘committed’ or ‘projected’, or it can relate to a ‘potential’ new contract clause. The consequences are different in each of the three cases.

A ‘committed’ financial conversion supply contract is defined when there is total certainty that the financial resources defined in the financial conversion supply contract will become available. Possible reservation states are ‘final’ and ‘planned’. If the financial resources supplied by the financial conversion supply contract are at the ‘final’ reservation state, this implies that these financial resources already have a fixed committed destination and cannot be used to fulfil the financial resource demand. The possible firm committed destinations were already described for committed operational demand contracts. Where the state is ‘planned’, this means that the destination of the financial resources defined in the financial conversion supply contracts is already indicated but can be overruled to fulfil the new demand for financial resources.

Financial resources that are specified in projected financial conversion supply contract clauses relate to the possibility that the organization has plans to convert and obtain the financial resources specified. However, there is no committed decision that this transaction will take place. The financial resources specified in the projected financial conversion supply contract clauses can be at ‘planned’ or ‘final’ reservation states. An example of a planned financial conversion supply contract clause at the ‘final’ state is the frozen amount of financial resources to be converted in the future, where the conversion has still to take place and there is therefore no detail available on timing and location. Financial resources at the ‘final’ state may not be taken into account to fulfil new financial resource demand as their destination is already firm. This implies that only financial resources defined in projected financial conversion supply contract clauses can be used to fulfil new financial resource demand.

A financial conversion supply contract clause potential relates to a new unplanned financial conversion supply contract clause insertion. Financial resources obtained by this new financial supply conversion contract clause can be reserved to service the new financial resource demand and receive the ‘final’ or ‘planned’ reservation states.

Processing the impact
On the basis of the HCFEM algorithm, each new or changed financial resource demand is compensated for. Compensation of financial resource outflows and changes in financial resource supply are the financial resource transition effect of the decision alternative. Financial resources are provided to resolve the financial resource demand by changing the reservation states of financial resource contract clauses (defining reservation states for new contract clauses, cancelling reservation states for existing contract clauses). The effect of cancelling the reservation can be described for financial resource *supply* contract clauses (supply-side, see Step 3) and financial resource *demand* contract clauses (demand-side, see Step 4).

7.4.4 Step 3: Processing the supply-side effect in the financial resource plan

Changes in the demand for financial resources have consequences for the future supply of financial resources. The following contract clauses can be influenced.

- Give relationship operational demand contract clauses (planned or final), e.g. future customer receipts
- Give relationship financial supply contract clauses (planned or final), e.g. future bank loans
- Give relationship financial conversion supply contract clauses (planned or final), e.g. future converted financial resources.

This is illustrated in Figure 7-5.

Impact on financial resource supply detailed in operational demand contract clauses (planned or final)
Where the reservation of financial resource supply defined in the give relationship in *planned* operational demand contract clauses and its destination (i.e. operational supply contract clause, financial demand contract clause or financial conversion demand contract clause) is cancelled, financial resources can be reused to compensate new financial resource demand.

Where the reservation of financial resources detailed in the give relationship in *final* operational demand contract clauses and its destination (possibilities defined in previous paragraph) is cancelled, three questions have to be answered. First, whether there is still other uncompensated demand for financial resources has to be determined. If this is the case, financial resources can be used to compensate this financial resource demand. If this is not the case then the second question is to examine whether there is future planned supply of financial resources (i.e. operational demand contract clauses, financial supply contract clauses or financial conversion supply contract clauses) that could be cancelled. Third, if this is also impossible, whether the final operational demand contract clause can be terminated should be evaluated. This is a purely theoretical scenario as the operational resources concern products and services already delivered to the customer (as the operational demand contract clause is final). Therefore, the financial resources given in exchange will be collected anyway, but there is an option to allow the customer to pay at a later date. These financial resources are not required to fulfil a planned or final demand for financial resources (checked earlier) and are maintained as inventory (e.g. in a bank account).

Impact on financial resource supply detailed in financial supply contract clauses (planned or final)
In situations where the reservation of financial resource supply detailed in the give relationship in *planned* financial supply contract clauses and their destination is cancelled (the same possibilities being available as defined for operational demand contract clauses), the financial resources can also be used to compensate new financial resource demand.

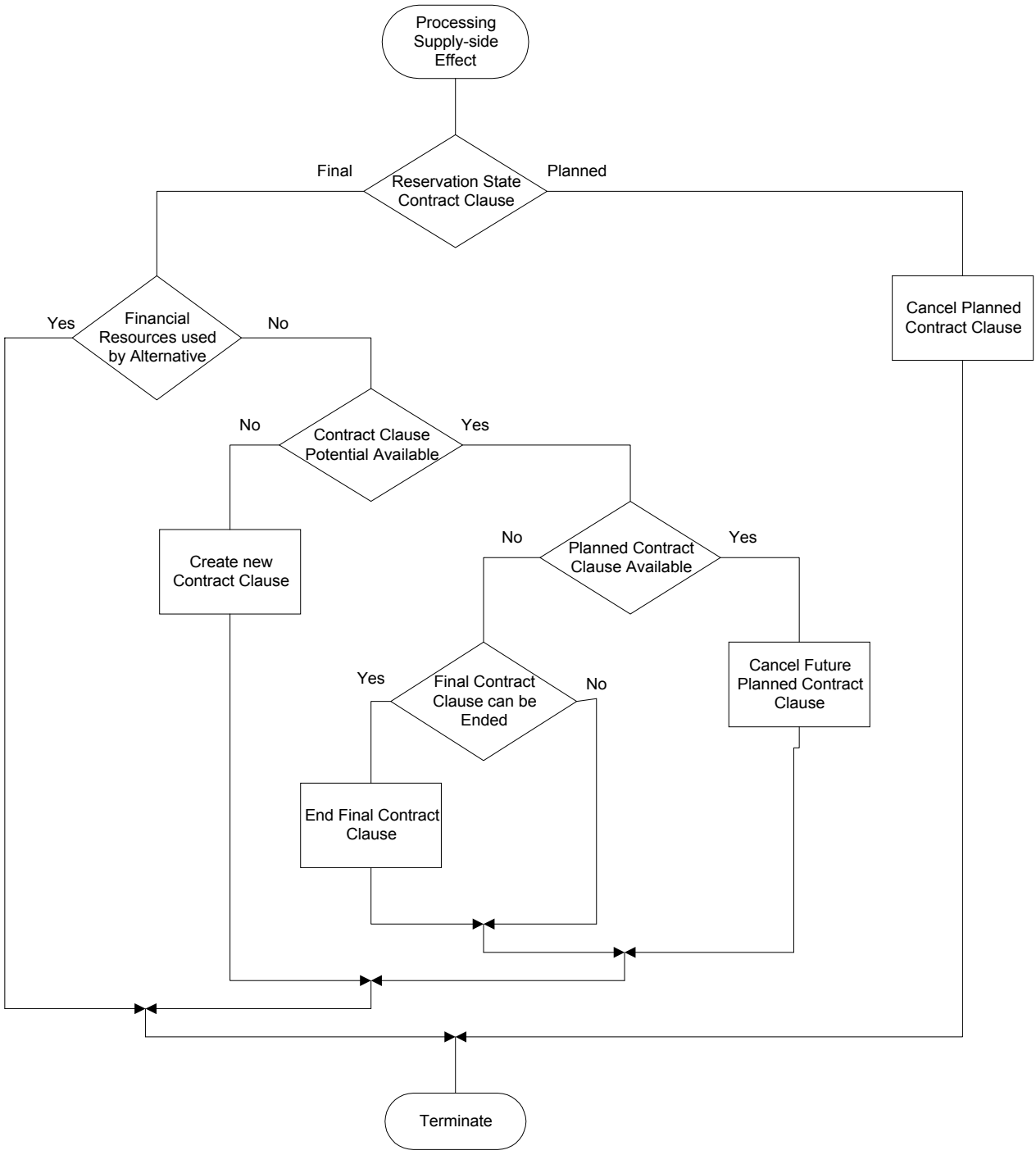


Figure 7-5. Real effect of reservation cancellation on the financial resource supply side

Should the reservation of financial resources defined in the give relationship in *final* financial supply contract clauses and their destination be cancelled (the same possibilities being available as defined for operational demand contract clauses), three questions have to be answered. First, it has to be checked whether there remains other uncompensated demand for financial resources. If so, financial resources can be used to compensate this financial resource demand. If not, then the second question is whether there is future planned supply of financial resources (i.e. operational demand contract clauses, financial supply contract clauses or financial conversion supply contract clauses) that could be cancelled. Third, if this is also

impossible, whether the final financial supply contract clause can be terminated should be examined. The latter option is possible when the final financial supply contract contains clauses whose terms allow intermediate termination.

Impact on financial resource supply detailed in financial conversion supply contract clauses (planned or final)
In situations where the reservation of financial resource supply detailed in the give relationship in *planned* financial conversion supply contract clauses and their destination is cancelled (the same possibilities are available as defined for operational demand contract clauses), the financial resources can be used to compensate other, new financial resource demand.

When the reservation of financial resources detailed in the give relationship in *final* financial conversion supply contract clauses and their destination (the same possibilities are available as defined for operational demand contract clauses), three questions have to be answered. First, it has to be checked whether there is still other unsatisfied demand for financial resources. If so, financial resources can be used to compensate this financial resource demand. Should there be no other demand, then the second question is whether there is future planned supply of financial resources (i.e. operational demand contract clauses, financial supply contract clauses or financial conversion supply contract clauses) that could be cancelled. Third, if this is also impossible, then whether the final financial supply contract clause can be terminated should be evaluated. The latter option is possible when the final financial conversion supply contract contains clauses whose terms allow intermediate termination.

7.4.5 Step 4: Processing the demand-side effect on the financial resource plan

The changes in the demand for financial resources also affect other future demands for financial resources (the demand-side effect). The following contract clauses are influenced.
Take relationship operational supply contract clauses (planned and final), e.g. future supplier or salary payments

- Take relationship financial demand contract clauses (planned and final). e.g. future interest payments
- Take relationship financial conversion demand contract clauses (planned and final), e.g. future financial resources to be converted.

The financial resource demand-side effect is illustrated in Figure 7-6.

When a reservation is cancelled in a supply of financial resources specified in *1)* the give relationship in operational demand contract clauses, *2)* the give relationship in financial supply contract clauses or *3)* the give relationship in financial conversion supply contract clauses, the consequence is that the financial resource demand can no longer be fulfilled. The demand for financial resources originates from *1)* operational supply contract clauses, *2)* financial demand contract clauses and *3)* financial conversion demand contract clauses (planned or final).

The following procedure is common to all of the different contract clause types. A recalculation of the financial plan is required beforehand lest the demand for financial resources as detailed in each of the three types of contract clauses still has to be compensated for (i.e. reservation is final). This rescheduling will re-prioritize this financial resource demand, for example by delaying other ‘planned’ state financial resource demands. This algorithm is illustrated by an example for each of the possible situations.

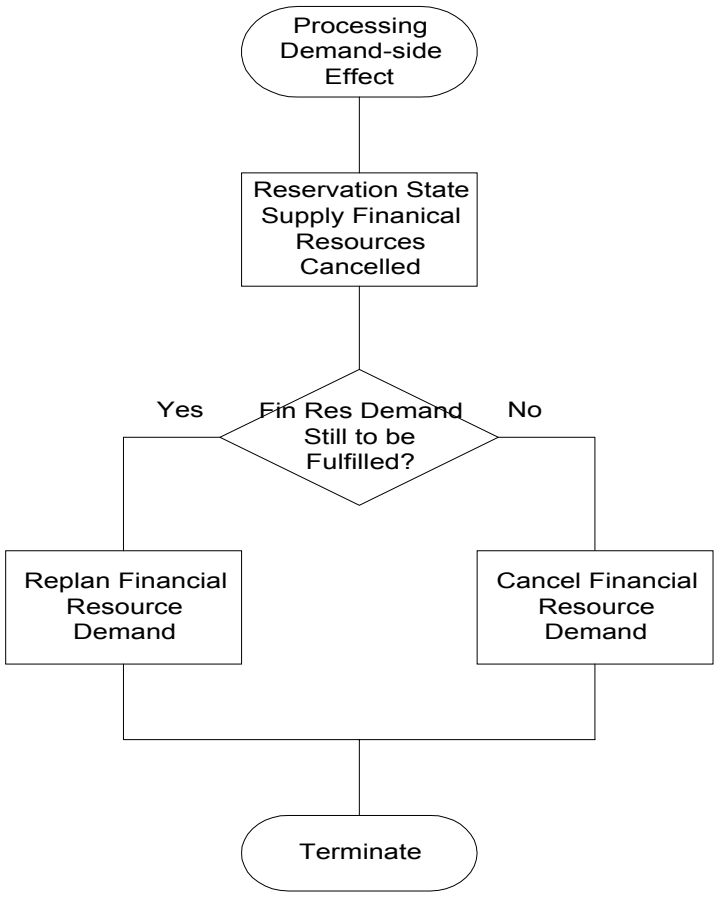


Figure 7-6. Real effects of cancellation reservation on the demand side

Impact on other financial demand detailed in operational supply contract clauses (final or planned)

Imagine the following situation. A supplier delivers raw materials today, and the terms of payment are the end of next month. The supplier payment of operational supply contract clause has to be carried out using financial resources obtained through customer receipts from operational demand contract clauses as prescribed by internal payment regulation rules. The terms of payment for customer receipts are one week. The organization also has an amount of financial resources available in a bank account, set at 'planned' reservation. If another operational supply contract clause is created with a supplier and payment is required by next week, the financial resources available in the bank account can be requisitioned. The reservation is cancelled and the reservation for the same amount of financial resources is now reserved at 'final' state to compensate for the new supplier payment. The first supplier still needs to be paid, a re-planning of financial resources is therefore necessary to also find adequate compensation for this outflow order.

Impact on other financial resource demand detailed in financial demand contract clauses (planned or final)

For example, an opposing financial party has allowed a one-week overdraft. The norms for handling this type of financial resource demand are detailed as follows. The organization usually uses the financial resources obtained through financial supply contract clauses to compensate for financial demand contract clauses. The terms on which financial opposing parties supply new financial resources through financial supply contract clauses are one week. There is also an available amount of financial resources on a bank account reserved at the 'planned' state. When the next financial demand contract clause is created with an opposing

financial party and settlement is required, for example immediately, the reservation of financial resources available in the bank can be cancelled and the reservation of the same amount of financial resources can now reserved at the 'planned' reservation state for the settlement of the new financial supply contract clause. Because the opposing financial party with whom the first financial supply contract clause was agreed still needs to be compensated, re-planning of financial resources is necessary.

Impact on other financial resource demand detailed in financial conversion demand contract clauses (planned or final)
An example of this case could be the following situation. A conversion demand contract clause was issued today. The converted financial resources are required next month. As a guideline for handling this type of financial resource demand, the organization uses financial resources obtained through financial conversion supply contract clauses for the settlement of financial demand contract clauses. The terms of conversion for opposing financial parties (e.g. international banks) are one week. However, the organization also has an amount of financial resources available in a bank account at a 'planned' reservation state. Another financial conversion demand contract clause is created afterwards, with settlement required by tomorrow. In order to find adequate compensation for this second contract, the reservation of financial resources available in the bank account is cancelled and the reservation of the same amount is now reserved at the 'final' reservation state for the new financial conversion demand contract clause settlement. As the opposing financial party with whom the first financial resource conversion contract was agreed still needs to be compensated, a rescheduling of financial resources is necessary.

7.5 Determining the financial equivalent of a treasury management decision: Cash Flow Equivalents[49]

This section discusses how financial resource flows triggered by a decision can be converted into a common denominator. Since *1)* there are different types of financial resources (e.g. loans, marketable securities, money in bank accounts etc.), *2)* the financial resource flow can be expressed in different currencies and *3)* financial resource flows can be executed at different moments (e.g. twelve monthly interest payments versus one annual interest payment), a unified means of expressing the equivalent of a quantity of a financial resource is required. The CFE is the common denominator for a financial resource amount converted into a single financial resource type (e.g. cash) of a single currency (e.g. the home currency) at a single specific moment. Decision alternatives can imply changes in the financial resources involved. These changes are expressed in terms of CFEs and compared to the original plan.

Two different types of financial implications can be discerned for a decision – the incremental effect and the opportunity effect. The incremental effect relates to the CFE of financial resource inflows and outflows without applying reservation logic (see Section 7.2.4). Where reservation logic is applied to consider the financial resource flows of decision alternatives, the opportunity effect has to be determined as well.

The financial impact of the incremental effect
The incremental effect of a decision consists of outflows and inflows. The outflows are invoked by new demand for financial resources. This new demand for financial resources was discussed in Step 1 of the HCFEM (see Section 7.3.2) and can be any combination of the following contract clause types.

- Take relationships in operational supply contract clauses (e.g. supplier payments)
- Take relationships in financial demand contract clauses (e.g. interest payment on a loan)

[49] Verdaasdonk (1998, p. 70-72) has presented a cash flow model to determine the relevant costs associated with business logistics decisions.

- Take relationships in financial conversion demand contract clauses (e.g. financial resources to be converted).

The inflows are invoked by the various options to solve the new demand for financial resources as discussed in Step 2 of the HCFEM (see Section 7.3.3) and can be any combination of the following contract clause types.

- Give relationships in operational demand contract clauses (e.g. customer receipts)
- Give relationships in financial supply contract clauses (e.g. loans offered)
- Give relationships in financial conversion supply contract clauses (e.g. converted financial resources).

The financial impact of the opportunity effect

The opportunity effect is determined by incorporating the effect of change in the reservation logic. The changes in contract clauses as described in Step 3 (processing the supply-side effect, see Section 7.3.4) and Step 4 (processing the demand-side effect, see Section 7.3.5) detail together the opportunity effect. Changes in the demand for financial resources can have an impact on the future supply of financial resources (the supply-side effect). The following contract clauses can be influenced.

- Cancellation of operational demand contract clauses (planned or future planned)
- Cancellation of financial supply contract clauses (planned or future planned)
- Cancellation of financial conversion supply contract clauses (planned or future planned)
- Termination of final operational demand contract clauses
- Termination of final financial supply contract clauses
- Termination of final financial conversion supply contract clauses.

The opportunity effects that result from influencing other future demand for financial resources (the demand-side effect), are described in the following contracts.

- Take relationships in (insert) new operational supply contract clauses (planned and final)
- Take relationships in (insert) new financial demand contract clauses (planned and final)
- Take relationships in (insert) new financial conversion demand contract clauses (planned and final)
- Cancellation of existing operational supply contract clauses
- Cancellation of existing financial demand contract clauses
- Cancellation of existing financial conversion demand contract clauses.

The totality of the effect of a decision alternative, converted into financial values can now be expressed as follows.

Incremental effect

- CFE of Operational Supply Contract Clauses (planned/final)
- CFE of Financial Demand Contract Clauses (planned/final)
- CFE of Financial Conversion Demand Contract Clauses (planned/final)
+ CFE of Operational Demand Contract Clauses (planned/final)
+ CFE of Financial Supply Contract Clauses (planned/final)
+ CFE of Financial Conversion Supply Contract Clauses (planned/final)

= = = = = = = = = = = = = = = = =

Incremental Cash Flow Equivalent

Opportunity effect

Supply-side Opportunity Effect

+ CFE of Cancellation of Operational Demand Contract Clauses (planned/future planned)
+ CFE of Cancellation of Financial Supply Contract Clauses (planned/future planned)
+ CFE of Cancellation of Financial Conversion Supply Contract Clauses (planned/future planned)
+ CFE of Termination of Final Operational Demand Contract Clauses
+ CFE of Termination of Final Financial Supply Contract Clauses
+ CFE of Termination of Final Financial Conversion Supply Contract Clauses

= = = = = = = = = = =
Supply-side Opportunity Cash Flow Equivalent

Demand-side Opportunity Effect
- CFE of New Operational Supply Contract Clauses (planned/final)
- CFE of New Financial Demand Contract Clauses (planned/final)
- CFE of New Financial Conversion Demand Contract Clauses (planned/final)
+ CFE of Cancellation Planned Operational Supply Contract Clauses
+ CFE of Cancellation Planned Financial Demand Contract Clauses
+ CFE of Cancellation Planned Financial Conversion Demand Contract Clauses
= = = = = = = = = = =
Demand-side Opportunity Cash Flow Equivalent
= = = = = = = = = = = = = = = = =
Opportunity Cash Flow Equivalent

= =
Total Cash Flow Equivalent

7.6 Example

This section provides an illustration of the HCFEM. In the example described below, only a few contract clause combinations are used. It is therefore not a demonstration of the full deployment of the HCFEM.

The Super Garden organization purchases and resells garden furniture. In the situation described below, only one product, 'Garden Set', is traded and one financial resource type 'USD on bank deposit' is used. This financial resource is maintained in Amsterdam and New York. Garden Sets are purchased in the Netherlands and sold in the Netherlands and the United States. No extra activities are performed on Garden Sets in addition to the trade activities. The Treasurer wants to decide how financial resource shortages can be financed in the most financially favourable way. Two financing alternatives are considered. Alternative 1, when a shortage occurs in a particular period at a particular location, it will be financed immediately and interest will be paid on the amount borrowed over the period it is used. It is assumed that amounts are received at the beginning of the period and paid back at the end of the same period. Alternative 2, the total shortage is determined on the basis of the MFS. It is borrowed at once at the beginning of the period in which the first shortage occurs and paid back entirely at the end of the period along with interest over the period that these additional financial resources were supplied.

The currency used to express Cash Flow Equivalents (CFEs) is the euro. The following currency rate are used: 1 USD = 0.95 EUR. The following rates are applicable for the activities defined next:

- Payment and collections in USD: rate 1
- Deficits in USD: rate 1.05 (5 % annual interest is paid)

The forecasted demand for 'Garden Set' is specified for 'the Netherlands' and 'the United States' markets and is stated in the table below.

Demand forecast 'Garden Set'				
Period	*4*	*5*	*6*	*7*
The Netherlands	5	10	20	20
The United States	5	10	20	40
Total	10	20	40	60

In each market, a specific sales price for 'Garden Set' applies. In Amsterdam, the sales price of the 'Garden Set' product is USD 1,000 while in New York, this price is USD 750. The inflow forecast for 'USD on bank deposit' is calculated in the table below.

Inflow forecast 'USD on bank deposit'				
Period	*6*	*7*	*8*	*9*
Amsterdam	5,000	10,000	20,000	20,000
New York	3,750	7,500	15,000	30,000
Total	8,750	17,500	35,000	50,000

The procurement (i.e. demand) for Garden Sets is visualized in the table below:

Garden Set				
Period	*6*	*7*	*8*	*9*
Planned Demand	10	20	40	60
On Hand (start of period)	0	10	10	10
'Give' Garden Set[50]	20	20	40	60
On Hand (end of period)	10	10	10	10

The lead-time for procurement of Garden Sets equals 2 periods. The lead-time of this resource is expressed by means of the required period availability (indicated by 'give', see table above for detail) and the moment at which they are contracted.

Garden Set						
Period	*4*	*5*	*6*	*7*	*8*	*9*
'Give' Garden Set			20	20	40	60
Contract Garden Set	20	20	40	60		

The purchase price of Garden Sets is USD 650. Purchases are made in the Netherlands and settled via the bank account in USD in Amsterdam in the same period of purchase. Using this information, the outflow forecast of 'USD on bank deposit' in the Amsterdam location is defined in the table below.

Outflow forecast 'USD on bank deposit'				
Period	*4*	*5*	*6*	*7*
Amsterdam	(13,000)	(13,000)	(26,000)	(39,000)

The Master Financing Schedule for resource 'USD on bank deposit' at the Amsterdam and New York locations is now defined on the basis of the information defined so far. See table below.

[50] 'Give Garden Set' is defined from the perspective of an external participant (i.e. the supplier). This expression means an expected external delivery of Garden Sets.

Master Financing Schedule – USD on bank deposit *Net balance before financing*						
Period	*4*	*5*	*6*	*7*	*8*	*9*
Amsterdam	(13,000)	(13,000)	(21,000)	(29,000)	20,000	20,000
New York	0	0	3,750	7,500	15,000	30,000
Total	(13,000)	(13,000)	(17,250)	(21,500)	35,000	50,000

The HCFEM contains the consequences on real financial resource flows and the CFE consequences. Reservations are recorded as follows. The reservation state is defined as 'final' (Fi.) or 'planned' (Pl.) and is set for a specific location where financial resources of 'USD on bank deposit' type are maintained. See the tables below for a description per contract clause type.

Planned Operational Demand Contract								
No.	*Take # Gar.Set*	*Reservation State:Location*	*Per.*	*Resource*	*Resource*	*Per.*	*Reservation State:Location*	*Give USD*
1	5	Pl: the Netherlands	6	Gar.Set	USD	6	Pl: Amsterdam	5,000
2	10	Pl: the Netherlands	7	Gar.Set	USD	7	Pl: Amsterdam	10,000
3	20	Pl: the Netherlands	8	Gar.Set	USD	8	Pl: Amsterdam	20,000
4	20	Pl: the Netherlands	9	Gar.Set	USD	9	Pl: Amsterdam	20,000
5	5	Pl: the United States	6	Gar.Set	USD	6	Pl: New York	3,750
6	10	Pl: the United States	7	Gar.Set	USD	7	Pl: New York	7,500
7	20	Pl: the United States	8	Gar.Set	USD	8	Pl: New York	15,000
8	40	Pl: the United States	9	Gar.Set	USD	9	Pl: New York	30,000

Planned Operational Supply Contract								
No.	*Give # Gar.Set*	*Reservation State: Location*	*Per.*	*Resource*	*Resource*	*Per.*	*Reservation state: Location*	*Take USD*
1	20	Pl: the Netherlands	4	Gar.Set	USD	4	Pl: Amsterdam	13,000
2	20	Pl: the Netherlands	5	Gar.Set	USD	5	Pl: Amsterdam	13,000
3	40	Pl: the Netherlands	6	Gar.Set	USD	6	Pl: Amsterdam	26,000
4	60	Pl: the Netherlands	7	Gar.Set	USD	7	Pl: Amsterdam	39,000

The Master Financing Schedule (before financing) indicates a shortage of financial resource 'USD on bank deposit' in periods 4, 5, 6 and 7. This shortage is found at the total level but is caused by a shortage in the 'Amsterdam' location. In financing alternative 1 as described earlier in this section, the amount needed was borrowed at the beginning of the period and paid back with interest at the end of (the same) period. This is defined as follows[51].

[51] It was chosen only to finance the shortages in the 'USD on bank deposit' financial resource per period in Amsterdam. It was assumed that enough other financial inflows are available to pay back the amount borrowed, increased with interest at the end of the period in which financial resources were borrowed. In practice, a more complex approach would probably be used, i.e. executing a netting operation between Amsterdam and New York first, and later financing the short net balance.

Planned Financial Supply Contract								
No.	*Give USD*	*Reservation State: Location*	*Per.*	*Resource*	*Resource*	*Per.*	*Reservation-state: Location*	*Take USD*
1	13000	Pl: Amsterdam	4	USD	USD	4	Pl: Amsterdam	13,054[52]
2	13000	Pl: Amsterdam	5	USD	USD	5	Pl: Amsterdam	13,054
3	21000	Pl: Amsterdam	6	USD	USD	6	Pl: Amsterdam	21,088[53]
4	29000	Pl: Amsterdam	5	USD	USD	5	Pl: Amsterdam	29,121[54]

The MFS in this scenario is defined as follows

Master Financing Schedule – Financing using Alternative 1						
Period	*6*	*7*	*8*	*9*	*10*	*11*
Amsterdam	0	0	0	0	20,000	20,000
New York	0	0	3,750	7,500	15,000	30,000
Total	0	0	3,750	7,500	35,000	50,000

The financial value of this plan can be calculated by considering the change in the 'USD bank Deposit' financial resource, expressed in Cash Flow Equivalent (CFE).

Incremental Effect		EUR
+	Operational Demand Contract Clause: Sales 'Garden Furniture'	105,688[55]
+	Financial Supply Contract Clause: New Loan Period 2	12,350[56]
+	Financial Supply Contract Clause: New Loan Period 3	12,350
+	Financial Supply Contract Clause: New Loan Period 4	19,950[57]
+	Financial Supply Contract Clause: New Loan Period 5	27,550[58]
-	Operational Supply Contract Clause: Pur. 'Garden Furniture'	(86,450[59])
-	Financial Demand Contract Clause: Repay Loan Period 2	(12,350)
-	Financial Demand Contract Clause: Repay Loan Period 3	(12,350)
-	Financial Demand Contract Clause: Repay Loan Period 4	(19,950)
-	Financial Demand Contract Clause: Repay Loan Period 5	(27,550)
-	Financial Demand Contract Clause: Interest Payment Period 2 to 5	(301[60])
		==========
Incremental CFE		18,937
Opportunity Effect		0
		==========
Opportunity CFE		0
		==========
Total CFE		**EUR 18,937**

The Treasurer wants to make a final decision on expanding the amount of 'USD on bank deposit' at the Amsterdam location. Alternative 1 was financing shortages at the moment at

[52] 13,000 * (0.05/12 + 1) = EUR 13,054
[53] 21,000 * (0.05/12 + 1) = EUR 21,088
[54] 29,000 * (0.05/12 + 1) = EUR 29,121
[55] USD 111,250 * 0.95 = EUR 105,688
[56] USD 13,000 * 0.95 = EUR 12,350
[57] USD 21,000 * 0.95 = EUR 19,950
[58] USD 29,000 * 0.95 = EUR 27,550
[59] USD 91,000 * 0.95 = EUR 86450
[60] (USD 54 + USD 54 + USD 88 + USD 121) * 0.95 = EUR 301

which they occur. Alternative 2 was temporarily expanding the volume of 'USD on bank deposit' financial resources by 76,000 (i.e. the cumulative shortage amount) from period 4 to period 7 (included). This alternative leads to the definition of a final financial supply contract for USD 76000 at the Amsterdam location, see table below.

Final Financial Supply Contract								
No.	Give *USD*	*Reservation*	Per.	*Resource*	Resource	*Per.*	*Reservation*	Take *USD*
5	76,000	Fi: Amsterdam	4	USD	USD	7	Fi: Amsterdam	77,267[61]

As a result of defining one final financial supply contract detailing the entire shortage over period 4 to period 7, the planned financial supply contracts (i.e. contracts 1 to 4 inclusive) covering the individual period shortages, are deleted. The MFS now looks as follows.

Master Financing Schedule – Financing via Alternative 2						
Period	*4*	*5*	*6*	*7*	*8*	*9*
Amsterdam	63,000[62]	50,000[63]	29,000[64]	(1,267)[65]	20,000	20,000
New York	0	0	3,750	7,500	15,000	30,000
Total	63,000	50,000	32,750	6,233	35,000	50,000

The financial effect on this decision is then determined as:

Incremental Effect		EUR
+	Financial Supply Contract Clause: New Loan Period 2	72,200[66]
-	Financial Demand Contract Clause: Repay Loan in Period 5	(72,200)
-	Financial Demand Contract Clause: Interest Payment in Period 5	(1,203[67])
		==========
Incremental CFE		(1,203)
Opportunity Effect		
Demand-Side Opportunity Effect		
+	Cancel Planned Financial Demand Contract clauses:	
	Cancel Planned interest payments	301
		==========
Total Demand-side Opportunity CFE		301
		==========
Total CFE		(902)

The negative total CFE is an indication that with regard to the original plan (i.e. alternative 1, shortage compensation when required), alternative 2 (compensating the total shortage amount over the entire plan period at the beginning of the first period of shortage) is a less favourable alternative from a financial perspective. The Treasurer will therefore choose alternative 1 in this situation.

[61] 13,000 * (0.05/12 + 1) = EUR 13,054
[62] USD 76,000 – USD 13,000 = USD 63,000
[63] USD 63,000 – USD 13,000 = USD 50,000
[64] USD 50,000 – USD 21,000 = USD 29,000
[65] USD 29,000 – USD 29,000 – USD 1,276 [interest payment period 2 until period 5 included] = (USD 1,276)
[66] 76000 * 0.95 = EUR 72200
[67] 72200 * ([0.05/12]*4) = EUR 1203

7.7 Statement of data requirements to support the HCFEM algorithm

In Sections 7.3 and 7.4, the HCFEM model was explained and a generic CFE calculation framework that can calculate the decision outcome of any treasury management decision scenario was proposed. The objective was to enable the HCFEM model to be implemented in business information systems. In keeping with the focus of this dissertation, it was assumed that the critical element in the possibility of implementation would be found in the availability of sufficient data in the data model. One additional generic data requirement that was a prerequisite to supporting the HCFEM in the data model was therefore outlined. The generic data requirements to support treasury management decisions as outlined in Section 6.4 of Chapter 6 are all prerequisites to supporting HCFEM too.

Requirement: MRP Netting Reservation Logic. The information system design must support different planning states like 'planned' and 'final' to indicate with different levels of certainty whether financial resources will be available at specific points. The information system must also distinguish between financial resource flows known at the moment of planning, and incidental financial resource flows.

7.8 Summary

This chapter tested whether there are additional requirements for data availability on the contract data model because of the application logic of the hierarchical treasury management decision-making algorithm, described as the Hierarchical Cash Flow Equivalent Model (HCFEM). The HCFEM was presented as a resource spending definition to support treasury management decisions at various levels with relevant costs. To define a financial plan in which the availability of financial resources with different levels of certainty is expressed, the reservation logic of the MRP netting algorithm as defined in the domain of business logistics has been adopted. The outcome of the model is a calculation framework in which the incremental and opportunity consequences of each decision alternative are expressed in a common denominator called the Cash Flow Equivalent. This calculation framework was illustrated by an example. The HCFEM was described as the definition of relationships between contract types and can be seen as an example of an application of 'contract-based accounting' (see Section 2.5 of Chapter 2). The HCFEM algorithm was described as a contract-based accounting application as it readily enabled the identification of missing data in the data model. Not being a goal in itself, it was re-emphasised that the goal of the validation was to understand whether the contract data model could hold sufficient data. Whether the contract data model as proposed in Section 4.4 of Chapter 4 can hold sufficient data to support hierarchical treasury making (as explained in Section 5.5 of Chapter 5) serviced with *ex post* and *ex ante* data (as explained in Chapter 6.3 of Chapter 6 and 7.3 and 7.4 of Chapter 7) remains in question. This validation will be carried out on the basis of the generic data requirements on treasury management decisions as summarized in Section 6.4 and the additional data requirements on the HCFEM model as summarized in Section 7.7. This will be the subject of the next chapter.