Accounting information for changing business needs

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Summary

This research concentrates on the question of defining an improved data model for ERP systems that can hold the data to service the business information needs of a wide user base from a single data environment. Research into better data models has already been carried out by a large number of scientists. Therefore, it was first investigated whether current ERP systems have adopted the available research results and whether limitations on data availability to service existing, new and/or changing information needs still apply. This was approached through a literature analysis and was illustrated afterwards by an empirical evaluation of characteristics of business process instance data recording in a representative sample ERP system. The following four findings were made.

1. There is no equivalent of the business process instance at data level. Data on a single activity instance are persistently stored, but the activity instance network (i.e. the business process instance) itself is lost at data level
2. Each finished activity instance of the business process instance leads to business process instance state, domain-specific data recording. This business process instance state data is stored in isolation and not as sub-category of a business process instance
3. If data on a single business process instance are not stored structurally, then a structured data organization over different business process instances cannot be expected
4. Business process instance data are not organized using REA or 'Grundrechnung' principles. No other equivalent data storage object is used to organize business process instance data. Double-entry bookkeeping is implemented as a data storage method to support financial information needs.

The literature analysis and the empirical evaluation of data storage in a current representative ERP system revealed that although several research initiatives have focused on finding improved data models there is still sufficient justification for additional research, as research results available today are not suitable for designing data models of large ERP systems. The two main requirements for the data environment of ERP systems are 1. that data stored in the data model have to be suitable to service existing, new and changing information needs and 2. that the data model must be sufficiently robust to be suitable in the context of large ERP implementations. In this research, the focus was on proposing a solution to the first question only.

The first part of the research relates to defining a new data model. The first step taken in the process to define a suitable data model is finding an appropriate data organization paradigm. In keeping with the advice of several authors, a data organization paradigm close to aspects of reality was chosen. This data organization pattern is the 'contract', the formal administration of a resource exchange, and was found by investigating the recurring pattern of different types of business transactions, data of which are currently stored via double-entry bookkeeping. Subsequently, a number of aspects of the contract principle were investigated, such as how contracts relate to organizations, why it is relevant to store internal contracts and how contracts relate to each other, resulting in the concept of the contract portfolio. The act of recording contracts was described as contract-based accounting.

The second step in defining a new data model is the definition of essential data components as design features of the chosen data organization paradigm. Two sets of design features were defined. The first relates to design features of the contract pattern to accommodate data storage of a single business process instance. Data of a single business process instance can be stored by detailing all aspects of an unrelated contract, like contract clauses, contract terms, contract participants, etc. The second set of design features concern the data definition of the

relationships that can arise between business process instances. These relationships are defined in the data model through design features based on relationships between contract clauses, which complete the concept of the contract portfolio as highlighted in the previous paragraph.

The third and final step in the definition of the new data model concerns the translation of the data organization paradigm and the design features into a data model architecture designed following a chosen data modelling technique. This was achieved by proposing three specific object models, designed in UML. The first model (i.e. the Contract Clause Pattern Model) is a model that allows resource exchange data storage through contract clauses and the relationships between contract clauses. The second model (i.e. the Fulfilment Pattern Model) concerns the storage of resource exchange execution data (e.g. invoicing, delivery, payment, etc.). The third and final model (i.e. the Contract Pattern Model) is an integration of the Contract Clause Pattern Model and the Fulfilment Pattern Model and accommodates a full contract administration, as prescribed by contract-based accounting.

The second part of this research concerns the validation of the proposed contract data model. As discussed above, the research objective focused on in this dissertation relates to the definition of a data model suitable to service *new* or *changing* information needs. The process of validation is therefore initiated by defining a new application as the first step. Step two is the requirement definition of this new application. Step three refers to detailing an algorithm that supports the calculations required in the chosen application. Finally, step four is the actual validation. Whether sufficient data are stored in the new contract data model for servicing the information needs of the chosen application and enhancements as described was investigated. Each of the four steps is then described in detail.

As highlighted in the previous paragraph, the first step in the validation process is the outline of a new application. A new application was deliberately chosen over an existing application, as new applications have the same characteristics of changed information needs from a user perspective. Hierarchical treasury management decision-making was chosen as the new application, as this approach had not yet been adopted in daily treasury practice and was therefore suitable as a new application. Hierarchical treasury management decision frameworks were outlined for three different types of decision-making: centralized, decentralized and hybrid decision-making. Hybrid decision-making was illustrated as the most appropriate for servicing real-life situations and was therefore used in the remainder of the validation process. The following decisions were supported in the hybrid decision framework. *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, *6)* Optimizing Financial Resource Conversion Orders and *7)* Optimizing Financial Resource Safety Stock Levels.

The second step in the validation process is the requirement definition of the chosen application. In the previous paragraph, the application used for the validation of the contract data model was outlined as hierarchical treasury management decision-making. Decisions can be supported by all kinds of information, varying from non-financial information to financial information. This research chose to service these decisions with relevant cost information, specifically incremental costs and opportunity costs. Detail was first presented on the scope of the decision for each of the seven treasury management decisions. Which accounting information was required to support the decision with relevant cost information was then explained and finally, requirements for data availability were defined. The requirement process was finalized by defining a generic statement of requirements for data availability applicable for all decisions.

The third step in the validation process was the definition of a calculation algorithm suitable for servicing the calculation of incremental and opportunity costs (i.e. relevant costs) for each of the seven treasury management decisions generically. To define this algorithm, an algorithm from business logistics (i.e. MRP Netting) was borrowed and redefined into a suitable algorithm for financial resource scheduling. A new term (the Cash Flow Equivalent – CFE) was introduced to make financial resource flows with different characteristics mutually comparable. The proposed algorithm (i.e. the Hierarchical Cash Flow Equivalent Model) results in a CFE calculation framework that accommodates the calculation of the CFE outcome of each of the decision alternatives in a specific decision-making situation.

The fourth and final step in the validation of the contract data model is to investigate whether the data model still complies with the new requirements for data availability that result from the seven treasury management decisions on one hand, and from the definition of the HCFEM model on the other hand. The following conclusions were made at the end of this validation process. The proposed contract data model was able to hold appropriate *base* data to service hierarchical treasury management decisions with relevant cost information. However, a number of enhancements had to be made to comply with specific features of hierarchical treasury management decisions (e.g. the accommodation of features like aggregated locations and family financial resources) and with HCFEM model features (e.g. the accommodation of MRP netting reservation logic together with calendar functionality). These enhancements were processed and an elaboration of the Contract Pattern Model was proposed as finalization of the validation process.