Reference Modelling of the Financial Reporting Supply Chain Architecture

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Abstract: The domain of business reporting and especially financial reporting plays an important role when discussing internal and external information flows among organizational units. The research literature addresses the financial reporting domain often as a financial reporting supply chain. This paper explores the FRSC and addresses whether there exists a theory for the internal and external company data exchange and especially for the financial reporting flow from the management information systems (MIS) perspective. The goal of this paper is to construct the FRSC architecture and analyse its potential in the context of reference modelling.

1 Introduction

The domain of business reporting and especially financial reporting plays an important role when discussing internal and external information flows among organizational units. The research literature addresses the financial reporting domain often as a financial reporting supply chain (FRSC) [Wa07]. With the introduction of information systems for enterprises, financial reporting was often discussed as a part of the accounting information systems (AIS) literature [SA02]. Nevertheless, the supply chain character and information systems context of financial reporting are rarely considered in the research literature in any theoretically constituent manner [Su06]. This paper explores the FRSC and addresses whether there exists a theory for the internal and external company data exchange and especially for the financial reporting flow from the management information systems (MIS) perspective. The goal of this paper is to construct the FRSC architecture and analyse its potential in the context of a reference model. The study proceeds as follows: chapter two provides analysis of the financial reporting domain. The subsequent chapter three presents the results as a set of financial reporting domain models discussed in the context of the FRSC architecture. The following chapter four provides the evaluation of the modelled architecture on the basis of reference modelling approach. The final fifth chapter presents the conclusions and the limitations of this study and suggests opportunities for future research.

2 Financial Reporting Domain Analysis

The reference models for FRSC are discussed in neither financial accounting nor AIS literature. Turning the point of view to practical implementations, SAP R/3 seems to be a

candidate for offering a FRSC reference model. According to SAP itself, their implementations are based on best practices, The term *best practice* is based in the anglo-american business administration literature. Best practice is all about not *re-inventing the wheel*, but learning from others and implementing what has been shown to work with the result that the enterprise is an example for other comparable companies. This statement requires a benchmark process to be able to identify the best enterprises within a specified group. Lower rated companies have a clear orientation to improve their performance. Due to this reason, we can state that a reference model is, in best case, best practice and generic. Surprisingly, SAP R/3 does not offer an implemented FRSC, probably due to the fact that in traditional AIS the financial reporting ends with the production of the report and not with reporting processes. In order to provide background information for the modelling of financial reporting domain the analysis of financial accounting and AIS literature was performed. To extend the results of literature research, we conducted a survey with selected participants of the financial reporting domain. This section provides an overview of the scenarios selected for further analysis and considered for the survey. This study regards internal receivers discussed by Wagenhofer and Ewert [WE03] as well as the groups of systematisers, data providers and intermediaries as important part of the FRSC but not directly related to the reporting scenarios. The reporting scenarios considered in this study are listed and explained in table 1.

Table 1: Selected Reporting Scenarios[1]

Reporting scenario	Description	Receivers analysed
Auditor reporting	Conveying of the financial reports to the auditor for the needs of audit procedures	Big four auditors
Group reporting	Reporting of a subsidiary to its parent entity	Parent entities
Capital markets reporting	Reporting of public companies regulated by stock exchange regulations to the investors, analyst and stock exchange, but not related to supervisory reporting	Frankfurt Stock Exchange
Statutory reporting	Reporting regulated by local GAAPs and related to the publication of financial report in generally accessible media	German Business Register
Supervisory reporting	Reporting regulated by the stock exchange supervision of the publicly traded companies	Federal Financial Supervisory Authority
Tax reporting	Reporting related to the submission of the financial reports to the tax offices for the purpose of calculating tax values	Freiberg and Dresden tax offices
Credit risk reporting	Reporting to the credit risk management divisions of commercial banks for the needs of credit risk assessment and ratings	Deutsche Bank AG and Freiberger Bank eG

[1] The various views on the users of financial reports together with their requirements were the background of the XBRL for External Reporting (XER) research project. Significant part of the XER project was the set of interviews conducted with a number of participants of financial reporting. The interviews were conducted from September 2006 till January 2007 at the Chair of Information Systems at TU Bergakademie Freiberg (Germany). The survey examined the reporting of entities to various groups of receivers, referred to as reporting scenarios in this study. The goal of the survey was to prepare background information and an overview of the financial reporting in Germany. The researched reporting scenarios were selected due to their importance and comprehensibility in the context of the financial reporting in Germany and analysed thoroughly. The reporting scope was limited to the financial reports of public companies and thus the internal reporting aspects were excluded from the analysis similar as the consolidation issues. The aspect of financial and tax audit were discussed with interviewees mainly from the perspective of the receivers of the financial information and not in the context of auditing processes.

3 Reference Model of the FRSC

The modelling of the FRSC architecture is conducted on two stages over six views of the Zachman architecture framework. Becker and Schütte [BS04] indicate other approaches for structuring information systems architectures such as the Semantic Object Model (SOM) from Ferstl and Sinz or the Architecture of Integrated Information Systems (ARIS) from Scheer. This study regards Zachman as most comprehensive of the discussed architectures, because of the six views provided and different abstraction levels enabling generic but also specific modeling. The highest level of abstraction is the contextual level. The important items should be listed here for the needs of modelling them on more detailed levels later. Further the conceptual view provides set of models on the modelled system of objects which explains it in more comprehensive way. The contextual and conceptual levels are analysed in this chapter. They start with the data view and go over function, people and network views. The result of the modelling is the financial reporting supply architecture.

3.1 Data View in FRSC Architecture

The first analysed category addresses the data components which can be identified in the FRSC. Schütte and Becker indicate the high importance of the data view modelling [SB04]. This study extends the understanding of the data view provided by Zachman and shared by Schütte and Becker. It introduces the distinction between the data itself and the data description. Such a distinction is known from the ontology domain and is discussed by Fensel. He indicates that both XML schema and ontology languages have the main goal in common which is providing vocabulary and structure for description of information sources that are aimed at exchange [Fe04]. Table 2 presents an overview together with descriptions of data components in the FRSC.

Table 2: Data Components in FRSC

Data component	Description
Source document	Original record of each transaction
General journal	A book of original entry in a double-entry system
General ledger	Collection of the company's accounts
Trial balance	Listing of all debit and credit balances in ledger accounts
Adjusted trial balance	Listing of all debit and credit balances in ledger accounts after adjustments at the end of the reporting period
Financial statements	Statements compromising of balance sheet, income statement, cash flow statement, statement of changes in the equity and the explanatory disclosures together with auditors' report on financial statements
Tax financial statements	Financial statements adjusted to the tax regulations
Additional information	Information necessary to create financial statements not included in the trial balance generated from general ledger systems
Audited financial statements	Financial statements after audit together with auditors' report
Financial report	Audited financial statements together with the management report and other reports

The data oriented view on the FRSC is also addressed by DiPiazza and Eccles. The data components discussed in table 2 are strongly related to their value chain of the financial

information [DE02]. Table 3 presents the data structures defining the structure of the data components shown in table 2.

Table 3: Data Structures in FRSC

Data structure	Descriptions
Chart of accounts	Specifies each type of asset, liability and owners' equity assigning a code number for each account
Accounting standards	Conduct followed by accountants as prescribed by an authoritative body or law
Additional regulations	Number of other regulations influencing the composition of the structure of data in the FRSC such as for example banking regulations specifying business assessment structure, tax code specifying additional items required in the tax reporting scenario and others

The contextual level provides only a list of data components and list of data structures which can be identified in the FRSC. In order to conduct a more detailed analysis the second level of Zachman architecture framework is modelled. The conceptual level for the data view is represented using an entity-relationship model (ERM) presented in figure 1.

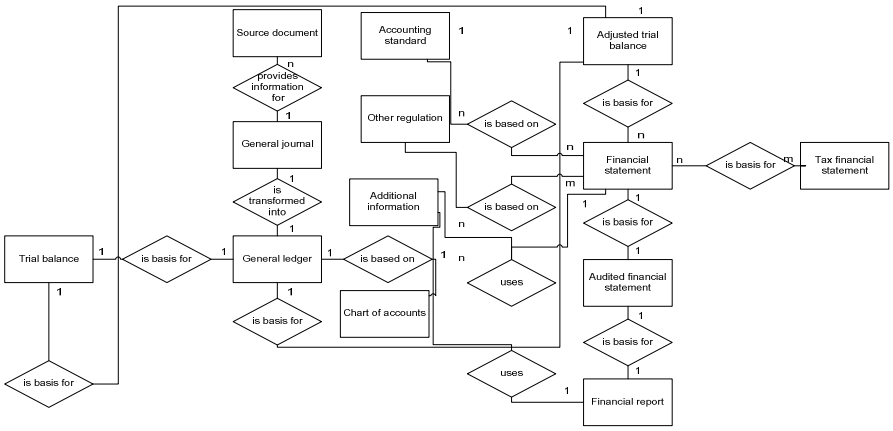

Figure 1: Data Model of the FRSC

The ERM combines the data elements from the contextual view based on analysis conducted in the second chapter. Figure 1 presents entities as data components as well as data structures and relationships between them. A number of source documents manually introduced in the accounting information system (dialog processing) or being result of a batch processing are the basis for the single general journal and single general ledger. The underlying structure for the general ledger is defined in the chart of accounts specific for a company which is often extended from the national guidelines or regulations for a chart of accounts [De06]. The general ledger is the basis for the trial balance which adjusted in a number of additional transactions leads to an adjusted trial balance. The aggregations and splits of the adjusted trial balance lead to the creation of the first part of

financial statements. The part of the financial statements which can be created automatically from the adjusted trial balance is limited and therefore additional information is required to complete financial statements and create a financial report. Both financial statements and financial report are based on one accounting standard. The audit process finishes with auditors' report which constitutes, together with management report and other reports, the audited financial report.

3.2 Function View in FRSC Architecture

The second analysed view is the function view. The MIS literature provides distinction between modelling of functions and processes [BS04]. But the Zachman architecture framework explicitly addresses modelling of processes in the function view which is applied in this study [St06]. Also Mertens indicates the close relation of processes and functions [Me07]. This study follows the understanding of Zachman and extends it to the understanding of Becker and Schütte where unambiguous definition of process places it as a consecution of functions [BS04]. Firstly contextual level includes the list of function items important from the FRSC point of view. Table 4 provides an overview of the processes.

Table 4: Processes in FRSC

Function item	**Description**
Recording transaction	Analysing and providing a track of record for each transaction (conducted automatically in the system or manually entered)
Journalising	Transferring data from source document to the general journal
GL posting	Transferring the data from general journal to the general ledger
Trial balance preparation	Closing the accounts and providing a list of all debit and credit accounts
Adjusting trial balance	Introducing adjustments to the trial balance at the end of the period, making adjusting entries, preparing closing entries and finally preparing closing trial balance [De06]
Financial statements preparation	Transferring data from adjusted trial balance to financial statements using aggregations and splits of different accounts and using additional information
Auditing	Providing the assurance on the financial statements and producing an auditors' report
Financial report preparation	Preparing a comprehensive set of audited financial statements, together with management report and other reports
Report consolidation	Transferring financial statements of subsidiaries into the financial statements of the group
Report delivery	Physical transfer of financial reports between company and its stakeholders
Report publication	Publishing financial reports
Report archiving	Storing financial reports for further needs
Report analysis	Analysis of financial information from financial reports

In order to represent and model, the function view EPC are used. Becker and Schütte address EPC as a comprehensive method of process modelling [BS04]. Figure 2 shows graphical representations of accounting cycle, report preparation and reporting processes within the FRSC. The accounting cycle describes the input and output documents and

their processing used during repetitive accounting activities. This cycle is repeatable for each occurring accounting event from the beginning of the process chain. The output of the transaction recording is a source document which can be either in paper or electronic format [BS04, 529]. Mertens indicates that around 30% of source documents must be entered manually into journal and GL systems while the rest is submitted from other application in machine readable form [Me07]. The source document is input[2] for the journalising process and the financial data is stored in the general journal and later posted to the general ledger. The accounting cycle ends when financial statements are requested. Somewhat differently from accounting cycle processes the report preparation processes are conducted usually at the end of the financial period or at the time when the report is requested. Information included in the general ledger is passed through a number of processes in order to prepare financial statements which are subject to audit. The adjustments to trial balance are usually conducted apart from the cases of preliminary statements when this process can be omitted. This is signalised by the *xor* component in the process model. Financial statement preparation output is a set of financial statements as well as, if necessary, a set of tax financial statements. Financial statements are subject to the audit and audited financial statements are output of this process. Finally a financial report can be prepared including all additional information for further reporting.

After the financial report is prepared, the reporting processes start. The requirement for the reporting starts with the report delivery process. This study addressed the report delivery also in the context of publication of financial reports by the company. The inputs for the delivery process are financial statements, financial report or tax financial statements. All three kinds of delivered reports can be archived or analysed depending on the reporting scenario. Usually, only financial reports are published, while both financial report and financial statements are input for the consolidation process.

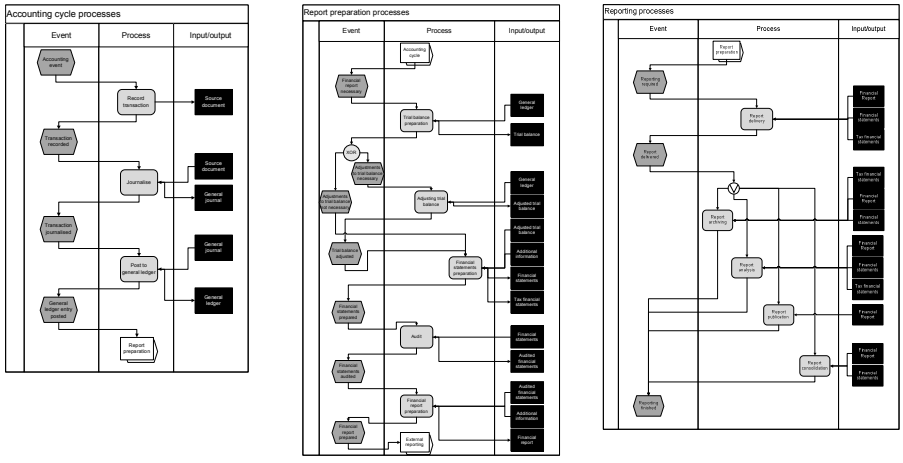

Figure 2: Process Model of Report Preparation in FRSC

[2] According to DATEV 100 journal entries generate about 270 GL entries [Me07].

3.3 People View in FRSC Architecture

This analysis focuses on the participants of the supply chain and their role in supply chain. Table 5 lists the participants with a brief description of their roles thus modelling the contextual level of the Zachman architecture.

Table 5: People Components in FRSC

Senders/ receivers	People components	Description
Senders	Accountants	Responsible for preparing the financial statements, financial reports and tax financial statements
	Management	Responsible for signing off the financial reports
Receivers	Auditors	Responsible for providing assurance on financial statements
	Parent company	Responsible for consolidation of financial statements
	Tax offices	Receivers controlling the reporting entities in the context of tax assessment
	Commercial banks	Receivers controlling the reporting entities in the context of the credit risk management
	Companies registers	Receivers responsible for publication of financial reports
	Supervising institutions	Receivers responsible for controlling the reporting entities and securing the capital markets
	Investors, analyst and stock exchanges	Stakeholders and shareholders interested in information about the reporting entities
	Others	Employees, customers and other potential receivers interested in information about the reporting entity

In order to ensure more detailed people view, the modelling on the conceptual level is provided. It is conducted with the use of the Responsible, Accountable, Consulted, and Informed (RACI) diagram, where responsibilities of participants of the FRSC can be modelled [IT05]. Additionally, the supportive role is used in this study thus implying the Responsible, Accountable, Supportive, Consulted, and Informed (RASCI) diagram which is the extension to the discussed RACI diagram. RASCI roles are assigned to processes discussed in function view thus enabling later integration of both discussed views.

Table 6 presents participants and their roles in processes performed within the FRSC. The RASCI diagram enables modelling five roles of different participants for listed processes. As presented in the table the majority of responsibilities from the processes concerning the accounting cycle and report preparation activities relates to the company's accountants, company's management and to auditors. Often for the financial statements and financial report preparation receiving institutions can be contacted and consulted in order to provide them with the correct reports. The report delivery needs to be conducted also by the accountants but the accountability is bear by the company's management. The consolidation processes are conducted by reporting company accountants often with auditors' support and also with support of the subsidiary's accountants. Usually all receivers are informed about the report delivery. Publication process is conducted either by the company itself, through the companies register or the stock exchange. Auditors, tax offices and supervisors are obliged to archive the reports. Finally, tax offices, commercial banks as well as investors and analysts are responsible for conducting analysis of financial reports.

Table 6: RASCI Diagram of People View in FRSC

	Accountants	Management	Auditors	Parent company	Tax offices	Commercial banks	Companies registers	Supervising institutions	Capital markets	Others
Recording transaction	R	A								
Journalising	R/A									
GL posting	R/A									
Trial balance preparation	R/A									
Adjusting trial balance	R/A									
Financial statements preparation	R	A	C		C	C		C		
Auditing	S	S	R/A							
Financial report preparation	R	A	C		C	C		C		
Report delivery	R	A	I	I	I	I	I	I	I	I
Consolidation	S	A	S	R						
Report publication	R	A	I				R/I		R/I	I
Report archiving			R		R			R		
Report analysis					R	R			R	

3.4 Network View in FRSC Architecture

In the context of this research, the network view describes communication components of the transmission of financial information. The network components consist of communication channels, communication means and communication formats. Table 7 lists all possible communication channels which are results of the analysis conducted in chapter three. Communication channel refers to the way used to convey financial information from sender to receiver.

Table 7: Communication Channels as Network Components of FRSC

Communication channel	**Description**
Personal	Handing the financial reports in a personal way (possibly on paper, USB, CD, etc.)
Post	Sending financial reports via postal way
Fax	Conveying financial reports via fax
Integrated systems	Enabling automated connection between the senders and receivers systems
Internet (HTTP, FTP, Web Services)	Sending the information over internet in electronic form without constant connection

The financial information conveyed by one of channels presented in table 7 can be physically conveyed by one of means of communication described in table 8.

Table 8: Communication Means as Network Components of FRSC

Communication Medium	**Description**
Paper	Using paper to capture the financial information
File	Using file(s) to encode the financial information

The possibility to transfer the data in an electronic way introduces next level of the complexity of the network view components which is communication format. A communication format refers to the data format of the transmitted electronic file. The overview of the data format used in FRSC is presented in table 9.

Table 9: Data Formats as Network Components of FRSC

Data format	Description	Automatic Processing
Text file	Word/RTF documents use for encoding financial reports	Publishing only
Hypertext Markup Language (HTML)	Use of websites to present financial reports	Publishing only
Spreadsheet	Use of Excel calculation spreadsheets to present financial information	Partly possible (semantic not supported)
Portable Document Format (PDF)	Use of internationally accepted file format for documents exchange	Publishing only
eXtensible Markup Language (XML)	Use of XML as format for encoding financial reports (other than XBRL)	Possible with semantic support
eXtensible Business Reporting Language (XBRL)	Use of XBRL instance documents and XBRL taxonomies to convey financial reports	Possible with increased semantic support
Proprietary data formats	Use of other data formats which are proprietary (software vendors or receivers owned formats)	Depending on the data format

Table 9 provides the overview of the formats possible for conveying of financial information in case a file is used as means of communication. The overview apart from the description delivers answers to the further automatic possibilities of the conveyed financial reports. Only XML and XBRL (and partly Excel) support further automatic processing of submitted reports. Further only XML and XBRL are able to provide semantic data structured for data submitted.

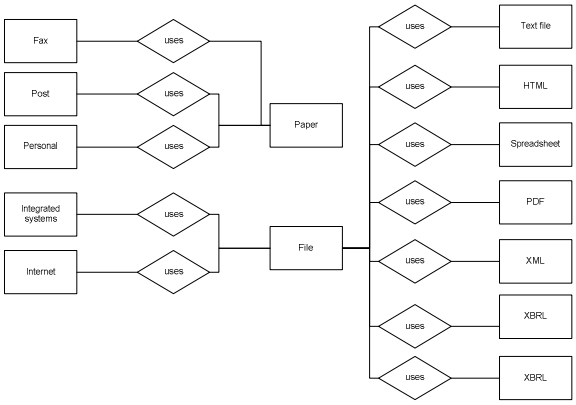

Figure 3: The Dependencies between Communication Channels, Communication Means and Communication Formats

The relationships between communication channels, means of communication and communication format presented in figure 3 provide an overview of the situation in communication network the FRSC. According to the results of the financial reporting

domain analysis, the traditional communication channels such as personal, postal or fax use paper as communication means. Modern communication channels such as integrated systems or use of the internet for communication between reporting and receiving institution are solely based on the electronic files. Reports on data storage and in a form of a file transmitted over the internet or through an integrated system are stored in a number of data formats. The range is from text documents, PDF or HTML files through spreadsheets up to XML and XBRL together with proprietary formats used in some reporting scenarios.

4 Verification

The modeling conducted in the previous section on the basis of the interview results is verified in this section. The results of the interviews were used again to validate the practical relevance of the constructed architecture thus enabling the evaluation of the research results. In this section FRSC architecture role as reference model is analysed. Reference models, according to the understanding of Schütte, can be used as a recommendation for the model users [Sc98]. The constructed set of models constituting supply chain architecture represents a target set of models which can be used as an orientation support for implementers. The classification as reference model can be assumed due to the fact that potential users of the architecture can later draw on the experiences documented in this study. Such understanding complies with Frank view on the architecture of integrated information system. Frank also indicates research potential of such reference information system for later adjustments and analysis of existing information systems [Fr94]. Similarly Brocke and Buddenick address the reusability of reference models in construction processes of other information models [BB04]. Out of scope of this study is objective evaluation of the modelled architectures. Such assessment can be only conducted as further research and evaluated by the architecture users and not architecture modellers. This study however follows the modelling theory as stated by Becker and Schütte and addresses in chapter two. This theory discusses evaluation of models by the use of Generally Accepted Modelling Principles (GAMP). All six GAMP are addressed in this section together with a brief discussion on each of them. Although not conducted be the model users, and thus not clearly objective, the following discussion provide a basis for further research and indicate potential directions of later verifications.

The principle of accuracy is positively (+) evaluated for both analysed architectures. The models are classified as syntactically and semantically correct. Principle of relevance is evaluated neutral (o) for FRSC architecture due to the fact that a number of simplifications are introduced in the models especially in the sections concerning the accounting cycle. The simplifications are due to the goal of modelling which are oriented on financial reporting. But is must be stated positively that the models present universal validity which increases their relevance. Also for the efficiency of both architectures similar evaluation pattern can be recognised. Neutral evaluation (o) of FRSC architecture is mainly due to the fact that there are a number of participants on the software and consulting market providing financial reporting products. It is important to note that objective evaluation of the relevance criteria can follow only outside of this study as further research. Both architectures respond equally high (+) to principle of systematic design as

well as to the principle of clearness. Firstly it is due to the usage of the Zachman architecture framework as meta-architecture for the modelled systems of objects. Secondly, this principle is evaluated positively, because of good readability of presented models. Finally, in case of the principle of comparability it is easier to compare FRSC architecture with a number of accounting systems architectures (+). To summarise the results, the FRSC architecture may be treated as a reference model.

5 Conclusions

The presented research indicates some limitations concerning the Zachman architecture framework. In order to provide generic results this study modelled financial reporting domain only on the contextual and conceptual level of the Zachman framework. An additional study seems to be necessary to extend the models for more specific levels such as logical (designer) and physical (builder) levels. Also modelling of some of the views is conducted on the high level of abstraction which causes issues when integrating them with the remaining views. An additional study using different modelling techniques, especially for people, time and motivation views, could significantly add to the presented results. The verification conducted in chapter six must be interpreted with caution. The verification of the relevance of the modelled system of objects is characterised by high level of subjectivity. The results from this study were verified by the models constructor thus are potentially subjective. A study that draws upon the GAMP and instantiates the architectures presented in this research would significantly add to the verification of results. Such study could use FRSC architecture and apply it for a certain reporting scenario. Such instantiation in form of a proof of concept could significantly prove the application of the presented architectures in practice. This study contributes to accounting research as MIS discipline as discussed by Sutton and Arnold [SA02]. Especially synthesis of real theories of design science and Zachman architecture framework theory gives the opportunity to provide a novel perspective on the financial reporting domain. Research relevance of this study for the MIS concentrates also on the design science aspects. Research relevance of this thesis aims in the first line at enhancing the MIS and AIS domains with the architecture of the FRSC. The relevance of this study for practitioners concentrates on the well-defined background for the analysis of the reporting supply chain and its components. Further this study enhances the costs assessment as well as improves project management especially while implementing MIS in financial reporting projects. Senders and receivers of financial information but also the financial intermediaries have the possibility to better understand the FRSC as well as use appropriate IT components for realisation of their goals.

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