

Financial objects – requirement analysis

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1 - Scope of this document

The financial objects work package is at the heart of the Smefin project. The success of the projects depends on the effective transfer of financial knowledge into actual decision processes by Sme's, and information systems and software solutions are crucial to such regard.

This document presents:

- the objectives stated in the FIRB research program approved by MIUR with regard to the financial object and related work packages, i.e. the contract to be honored;
- a summary of preliminary research done so far on this topic in our Department and in the other research units of the Smefin project;
- the milestones to be pursued, and the consequent refinement of the project's plan;
- some work hypotheses on "how to start".

This document is in English in order to allow the participation of non-Italian speaking people to the project's work, and hopefully create an international development community

1.1 References to other documents

[a] FIRB research program approved by MIUR (March 2004).

[b] Luca Erzegovesi (Feb 2002), *Dives PMI. Un progetto software per lo sviluppo di strumenti per la finanza delle piccole e medie imprese*, mimeo. Statement of the goals, scope and functional requirements.

[c] Luca Erzegovesi (Sep 2002), *Dives PMI. Un progetto software per il corporate financial management*, mimeo, work hypotheses on the software object model for representing financial concepts.

2 - Objectives stated in the FIRB research program

The financial objects WP is included in the 3rd Part of the program, regarding IT systems and decision-making processes to back up the financial management of Sme's.

This part of the project sets out to achieve an integrated analysis and evaluation model translated into a set of software components to support firms' financial planning. By using such components, systems can be developed in order to assist firms in the evaluation of investment projects, evaluation of the effective cost and sustainability of debt, corporate risk management, and the evaluation of companies for mergers and acquisitions. It consists of four strictly integrated WP's, from 09 to 12.

[WP09] defines the **integrated financial planning model**, considering the needs of internal auditing, financial reporting and the banking standards relating to credit rating.

[WP10] **Financial objects** (our focus here) develops a family of software components in Java language (or other object-oriented languages) implementing the following functions: processing of historical balance sheet data; processing of forecasted financial statements (pro-forma balance sheets and cash flow statements), based upon scenarios of key economic drivers; production of measurements of economic value and risk (e.g. EVA, cash flow at risk, bankruptcy risk); consolidation of the forecasted scenarios and the financial statements between corporate entities, with functions of currency conversion, allocation of common costs,

elimination of intercompany items, end-of-year corrections, minority interest management, interwoven holdings, voting rights.

In [WP11] **XBRL** the aim is to try out the XBRL (eXtensible Business Reporting Language) standard, an extension of the XML language which allows the definition of models for the exchange of accounting documents and financial reports in electronic format. In particular, the project will verify the possibility of applying XBRL for the exchange of data for the analysis of credit-worthiness, the evaluation of partners, and the consolidation of data within groupings of companies of various kinds.

[WP12] **IAS** assesses the impact on Sme's of the introduction of the IAS (International Accounting Standards), and the subsequent adaptation of the EU's accounting directives.

2.1 Review of WP's on financial decision support and IT systems

Let's now review the specific objectives, units involved, activities and deliverables declared for each of these WP's, as they have been set in [a]. This is a copy and paste with minor refinements and some comments.

2.1.1 Integrated financial planning model [WP09]

Description

Title: WP09 - IT systems: financial planning and analysis models for SMES and their integrated use for the purposes of internal auditing, financial reporting and credit rating procedures.

Co-ordinator: Giulio Tagliavini, University of Parma, professor of banking and finance.

WP09 defines the integrated financial planning model, considering the needs of internal auditing, financial reporting and the banking standards relating to credit rating procedures. WP09 also includes the functional analysis required as a preliminary step to the development of software components in WP10.

The planned activities are as follows.

T09.1 Survey of the literature, specific analysis methods for the purposes of SME's internal financial audits and professional best practice in the field of credit rating procedures. Case studies of structure analysis in the contexts of both banks and "confidi" (mutual guarantee societies) will be identified and analysed. The interest in procedural forms of analysis, both in the field of rating methods and in the more traditional field of qualitative and quantitative analysis will also be evaluated. One key point for consideration will be the handling of financial data not included in the official accounts, with regard to qualitative information about the attractiveness of the sector and the risks linked to the firm's strategic characterisation.

T09.2 Identification of the procedural requirements needed to support the work in the analysis protocol suggested. Those offering financial consulting require a "format" for interpreting firms' situations (with regard to both finance and balance sheet equilibria); normally, individuals are left to learn this skill by trial and error. This procedure is absolutely unsatisfactory and ineffective. Classroom education and self-training on these aspects are based mainly on methodological profiles that fall far short of the final aim of developing interpretation skills. Often, people are left with a faith in the efficacy of a simplified numerical approach (e.g. scoring); this is disappointing from the professional point of view and does not provide sufficient foundation for work as a consultant. This profile will be examined using the focus group method.

- T09.3** The development of software is normally based simply on data collection methods (accounting principles, balance sheet frameworks, analysis tools) and not on "company situation-oriented" interpretative approaches. The aim is to develop a logical network for the development of software which, taking the methodological aspect of the analysis as given and already available, proceeds to select the analysis profiles most appropriate to the individual situation. The aim is to create balanced scorecards which guide the consultant / mutual guarantee societies ("confidi") / financial manager / entrepreneur in various corporate scenarios.
- T09.4** Verification of the proposed analysis protocol through panel discussion and a field trial with the collaboration of banks and "confidi".
- T09.5** Identification of the final analysis protocol and the correlated rules for updating analyses.

Deliverables

- D09.1** Report on the research into the rules for the evaluation of companies' financial soundness using quantitative and qualitative information, with specific reference to the **credit rating models** applied to SMEs by Italian banks.
- D09.2 Article on the same subject** to be sent for publication to an international journal in the field of corporate finance and banking management.
- D09.3** Proposal of a logical structure for an analysis and **financial consulting procedure**.
- D09.4** Development of a **software prototype, based on web technology**, providing an example of the application of the analysis protocol.
- D09.5 Research report** covering the strong and weak points of the proposed procedure and the prospects for its use by operators working within professional or company networks (such as business offices). Report on the results of the panel discussion on the protocol proposed.
- D09.7** Report on the results of the **field trials**.

2.1.2 Financial objects [WP10]

Description

Title: WP10 – IT systems: software packages for financial planning and reporting

Co-ordinator: Luca Erzegovesi, University of Trento

[WP10] develops a family of software components in Java language (or other object-oriented languages) implementing the main functions required by the financial planning models, in line with the analysis conducted in WP09 and with the specifications relating to the XML-XBRL data model defined in WP11. The activities planned are:

- T10.1** Analysis of the requirements and specifications of the financial planning models to be implemented. The models must support the reclassification of historical balance sheets, the modelling of the company's value chain and the economic and risk drivers, and the simulation of forecast financial plans complete with income statement, balance sheet and cash flow statement. The financial planning components must support the typical decisions involved in corporate finance, i.e. the projection of business plans for new investments, capital budgeting and investment evaluation, verification of the sustainability of debt and evaluation of the company itself.
- T10.2** Selection of the programming framework and software development team.

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T10.3 Definition of the data model for consolidation and reporting.

T10.4 Technical analysis, coding and testing of the financial software's components.

T10.5 Beta test on a company case with the collaboration of an SME.

T10.6 Documentation and release of the final version.

Deliverables

D10.1 Document of **functional analysis** of the application components.

D10.2 Document of **comparative analysis of the hardware alternatives and software solutions**, based on selection criteria consistent with the functional requirements.

D10.3 Document with the XML-XBRL chart for implementation of the **XBRL data model**, with comments.

D10.4 Implementation of a **mapping of the XML data model on a relational model**, for implementation on leading DBMS (Oracle or MS SQL Server).

D10.5 Example of a spreadsheet of the **consolidation procedures** based on the data model.

D10.6 **Software objects** (Java classes) **which implement the business logic** (entities such as firms, value chain, input, product, risk factors, owners, creditors, inventory, fixed assets, financial instruments, etc.). The financial planning models will be constructed by combining these basic building blocks.

D10.7 **Software objects** (Java classes) **which implement the data services** by connecting the financial objects to the XML-XBRL data model (see WP11).

D10.8 Application **prototype with a basic graphic interface**, which provides an example of the use of the financial software objects in typical cases.

D10.9 Document which analyses the **requirements of the data interface** between our data model and the balance sheet data of a test firm.

D10.10 Software procedures which implement the **data interface** as specified in D10.9.

D10.11 Document which reports the results of the **field test**, specifying a list of upgrades to the financial software objects needed to improve their use in real situations.

D10.14 Release of the **application platform prototype** and the relative documentation.

2.1.3 XBRL [WP11]

Description

Title: WP11 – IT systems: supports for promulgation of the XBRL standard for the exchange of reports and financial communications

Co-ordinator: Paolo Giorgini, University of Trento, assistant professor of computer science.

In [WP11] the aim is to try out the XBRL (*eXtensible Business Reporting Language*) standard, an extension of the XML language which allows the definition of models, known as **taxonomies**, for the exchange of accounting documents and financial reports in electronic format. In particular, the project will verify the possibility of applying XBRL for the exchange

of data for credit rating, the evaluation of partners, and the consolidation of data within groupings of companies of various kinds. The activities planned are:

- T11.1 Analysis of the XBRL documentation on financial reports and a survey of experiences of application of XBRL in the field of financial analysis and credit rating.
- T11.2 Identification of an XBRL taxonomy for the planning of financial data (provisional version). This taxonomy will expand the taxonomies used for official balance sheets by adding the processing of the parameters of the computing model used for financial simulations and pro-forma balance sheets. These tools will be mapped on the financial objects defined in WP10.
- T11.3 Analysis of the prerequisites of a data interface between our financial planning platform and banks' loan assessment and credit rating procedures.
- T11.4 Preliminary implementation of the XBRL interface with the loan assessment procedures for testing in collaboration with a bank.
- T11.5 Identification of an XBRL taxonomy for the planning of financial data (final version).

Deliverables

- D11.1 Research **report** on the **applications of XBRL in financial analysis** and for credit rating.
- D11.2 Document with the XML schema for implementation of the **financial planning taxonomy (provisional version)**, with comments.
- D11.3 Example of XML documents demonstrating use of the taxonomy in significant case studies.
- D11.4 Document specifying the **data interface prerequisites**.
- D11.5 Report on the test involving preliminary implementation of the **XBRL interface with the loan assessment procedures**.
- D11.6 Document with the XML schema for implementation of the **financial planning taxonomy (final version)**, with comments.

2.1.4 IAS [WP12]

Description

Title: WP12 – IT systems: effects of the introduction of international financial reporting standards on small and medium enterprises

Co-ordinator: Mauro Zavani, University of Modena, professor of accounting.

One serious consequence of the failure to use a suitable reporting process might be the downgrading of small and medium enterprises' credit rating if financiers come to believe that the failure to use international accounting standards generates less transparency, leading to a higher risk level. With this in mind, [WP12] assesses the impact on SMEs of the introduction of the IAS international financial reporting standards, and the subsequent adaptation of the EU's accounting directives. The activities planned are:

- T12.1 Survey of the relevant literature and study of the evolution of the international financial reporting standards (IFRS), with particular attention to the proposals drawn up by the

International Accounting Standards Board (IASB) for the adaptation and extension of these standards to small and medium enterprises.

- T12.2 Study of the problems deriving from the possible failure to extend, or only partial extension of, the international financial reporting standards to those companies currently excluded from the application in Italy of European Regulation n. 1606 published in the European Gazette on 11th September 2002, which makes it compulsory for all listed European companies (and all companies providing banking and financial services) to adopt common accounting principles with effect from 2005.
- T12.3 Evaluation of the effects of the continuing existence of a category of companies whose size allows them to submit short-form balance sheets (under art. 2435-*bis* of the Italian Civil Law Code) and thus avoid compliance with the new accounting standards and the additional costs their implementation might involve. It is probable that the gap between companies which produce short-form balance sheets and others, in terms of transparency and completeness of financial information, will become even wider than at present, and that this may encourage firms not to expand beyond the IFRS applicability threshold.
- T12.4 Identification for the disclosure requirements and accounting procedures introduced by the IFRS which might, if adopted, have the greatest impact on small and medium enterprises' IT systems, because of the implementation of evaluation criteria and balance sheet presentation procedures different from those traditionally recommended by Italian accounting handbooks and principles.
- T12.5 Analysis of the effects the new requirements identified might generate on the main economic, financial and equity parameters of Italian small and medium enterprises and their IT systems, with the aid of simulations and case studies, with a view to these standards' general application. Specifically, the following will be studied: the effects of the introduction of fair value as the evaluation criterion for specific categories of assets and the problems of compliance with the resulting matching principles; the conditions for including intangible resources in balance sheets; the criteria for evaluating losses on fixed assets.

Deliverables

- D12.1 Report on the research into the effects of the introduction of the international financial reporting standards on Italian small and medium enterprises. The failure to extend the standards to all categories of firm might lead to problems of comparability in relation to companies' financial reporting. The need for the standardisation of evaluation and reporting processes also arises from the fact that firms' annual balance sheets are increasingly of interest to a larger and larger group of stakeholders, and nowadays it is no longer possible to overlook the growing weight of assets as a proportion of firms' capital.
- D12.2 One or more papers on the subject to be published in international journals in the field of accounting and the economic analysis of law
- D12.3 One or more documents recommending the method to be used for the writing and adaptation of software packages for financial planning and reporting (see WP10) in the light of the obligations imposed by the international financial reporting standards.
- D12.4 Final report on the adaptation and innovation of the accounting, auditing and finance function of Italian small and medium enterprises, in the light of the wider-ranging requirements for balance sheet disclosure imposed by the evolution of European accounting regulations. The report also intends, within the limits of its objectives, to

supply guidelines for the provision of professional services tailored to the changing needs of small and medium enterprises by business offices (see WP03). WP

2.2 Comments

In [a] we have committed to a set of challenging tasks. The XBRL and IAS WP's should not pose critical problems: they are focused and well encapsulated, and the interfaces to and from WP09 and WP10 are clearly specified. On the contrary, in WP09 and WP10 we run several risks:

- the scope of both of the WP's is very broad; a great amount of work is required in order to survey and refine established methodologies and solutions (see below for my review of available competing or complementary tools); there is a need for sharper focus on innovative results, resisting the temptation to reinvent the wheel;
- WP09 is presented as precedent to WP10, whereas the coordination between them should be an iterative process, because they overlap in the aspects of functional analysis and development of a working prototype usable by financial decision makers.

In order to tackle such potential problems we should be value conscious in our “production chain”, and try to reduce workload by purchasing or outsourcing the “mature” components of the envisaged system. In practice, we must capitalize on available third party software components, and rely upon standards in financial knowledge and methodologies (e.g. mandatory reporting standards, financial analysis formats endorsed by banking associations, etc.); the value added by our work should come from:

- building “infrastructural” components that leverage the power of individual end-user solutions, such as financial data exchange protocols based on XBRL, shared company information databases, spreadsheet add-ins for sharing information and collaborating among producers, processors and users of financial information, web financial portals;
- committing to the goal of doing something useful for practitioners, and pursue opportunities of knowledge transfer; projects in the field are crucial to this end;
- keeping a “short team” on the playing field, with frequent interaction; each unit should not work on its own. Convergence towards a common goal should not be taken for granted, as the people in the various units has already developed models for financial analysis, and one might be jealous of its creature;
- cooperating with other partners beyond the Smefin group, in the context of a wider audience; to this end, some components can be developed within open source communities, comprising non profit, institutional and commercial members, leveraging a larger pool of talent and resources.

3 - Preliminary activities done so far and available resources

At our department, the idea of a software platform for corporate finance dates back to 2002, within a research project on corporate risk management – Corprisk - coordinated by myself. In that context, we were short of time and money, and could not achieve substantial results. Some design considerations were sketched in two concise research reports (see [b] and [c]). Before and after 2002, we worked on several of the topics considered here. Relevant activities and results, grouped by research unit and WP are presented hereafter.

3.1 Integrated financial planning [WP09]

3.1.1 Activities at the University of Trento

For several years we have been working on several spreadsheet models for financial planning:

In 1999 I prepared the FINLAB Excel spreadsheet for my class of Corporate finance, it was a rather complex model for computing pro forma financial statements classified by function; the strength of the model was in the projection of incremental operating cash flow – or free cash flow to the firm – used in the evaluation of investment projects; the incremental flows were computed by comparing two distinct and complete forecasts with and without the project (in finance textbook one is usually taught to determine incremental values straight away, adjusting for “pitfalls”, e.g. sunk costs, product cannibalization, etc); the two spreadsheet models (after and before) were subtracted cell by cell from each other with a nice Excel formula trick I was very proud of. It had sophisticated formulas for tax adjustments and cross checks between stocks and flows. On the downside, FINLAB lacked a worksheet for the data entry of historical accounting data in the mandatory format and automatic reclassification of items. Its intricate computing flow, with formulas dispersed in several worksheets, made it difficult to extend or change the model. As a result, FINLAB was very rigid and cumbersome, and in practice it has been used only as course material for one fictitious business plan. I learned a lot from this disappointing experience.

In Spring 2003 Flavio Bazzana¹ prepared a model for a training seminar at the Trento School of Management (TSM model). The user had to input data in the form of historical balance sheets in an abridged version of the Italian official format, complemented by additional information. The model elaborated reclassified financial statements and ratio analysis. Flavio developed also a separate model for forecasted statements, with a rather simple computational structure. It was simpler than FINLAB, and more suitable as a tool for teaching financial planning at a beginner’s level.

In 2004, I asked a former student, Matteo Ragagni, to work on an extended version of the TSM model, recovering some of the features of FINLAB. The main improvements over the original model were the following:

- the statements include all the accounting items listed in the mandatory format (e.g. extraordinary income and expenses, equity investments with separate disclosure of interests in subsidiaries and associated companies);
- extra disclosure information is required in a more structured way and with finer detail; in particular, for each category of items in the balance sheet the user has to break down the net change in value during an accounting period by nature (e.g. change in net depreciable assets = investments – sales of assets – depreciation – impairment + revaluation); with this additional information one can derive the cash flow statement with precision;
- the treatment of tax expenses is more analytic (e.g. IRAP, a regional tax levied on value added, including personnel expenses, is decomposed into a social security charge and into an income tax component).

Matteo has tested the model on a sample of small size firms. Data gathering and input requires a great amount of work, but results are very accurate.

¹ Before joining DISA, Flavio has worked as credit analyst at Mediocredito Trentino – Alto Adige, a regional investment bank.

In 2004, Flavio developed a financial forecasting model for the evaluation of investments in public infrastructure, commissioned by the Province of Trento, which is currently in use. It is not a tool for corporate financial planning, being tailored to the life cycle of a single investment project in the stages of construction and operation.

In spring 2005 we collaborated with a local bank for a series of seminars for small firms. There we used the Bank's software application, Examiner, for financial statements analysis. Examiner produces a technical score that is used in the credit evaluation procedure. It was an interesting experience, offering us insight into the problems which are specific to smaller firms eligible for short form accounting ("contabilità semplificata" in Italian). Such problems are originated by the lack of reliable official balance sheets and by the confusion between business and personal assets and income.

3.1.2 Activities at other universities

The group at the University of Parma published a manual (Analisi finanziaria, edited by Eugenio Pavarani, Mc Graw Hill, now in its 2nd edition) which covers the main topics relevant to WP09. The book includes a CD with an Excel spreadsheet for both historical financial analysis and forecasting, although the forecasting model does not fully support the structured modeling of assumptions and value drivers. The group has also good skills and experience in training and consulting on the same topics.

At Urbino, Alessandro Berti has comparable competencies. He was involved in the development of the Examiner model (mentioned before) and has a practical approach matured in an extensive consulting activity.

3.2 Financial objects [WP10]

Activities on these topic have been carried on at Trento under my supervision.

In the experiences described before, I was made aware of the dilemma facing a guy who tries to improve upon existing models: either he ends up with yet another spreadsheet model for business plans, or embarks upon the quest for something more ambitious, at the risk of obtaining something that is too complicated and unusable.

3.2.1 Survey of existing software solutions for business financial planning

In September 2002 I did some exploratory work on supply and value chain modeling, in order to sketch an object model for basic financial concepts. First of all, I surveyed existing software applications "beyond Excel" in some way related to my target. What I found can be divided into five different categories:

First, we have **spreadsheets, spreadsheet add-ins, or spreadsheet-like standalone programs** used for financial analysis and reporting; these are rather light applications, based on a high level Chart of accounts (at the level of detail suitable for management reporting) and a straightforward computing engine, not too different from what you can do with Excel; these products produce reports for management and company stakeholders; in this category I put FINANSEER by Stern and Stewart (the EVATM company, see <http://www.sternstewart.com/software/finanseer.php>)

Rating agencies, too, distribute applications for financial statement analysis. These solutions are part of their offering of tools and database for the rating process. Similar functionalities can be found in numerous accounting software packages or in add-in to such applications.

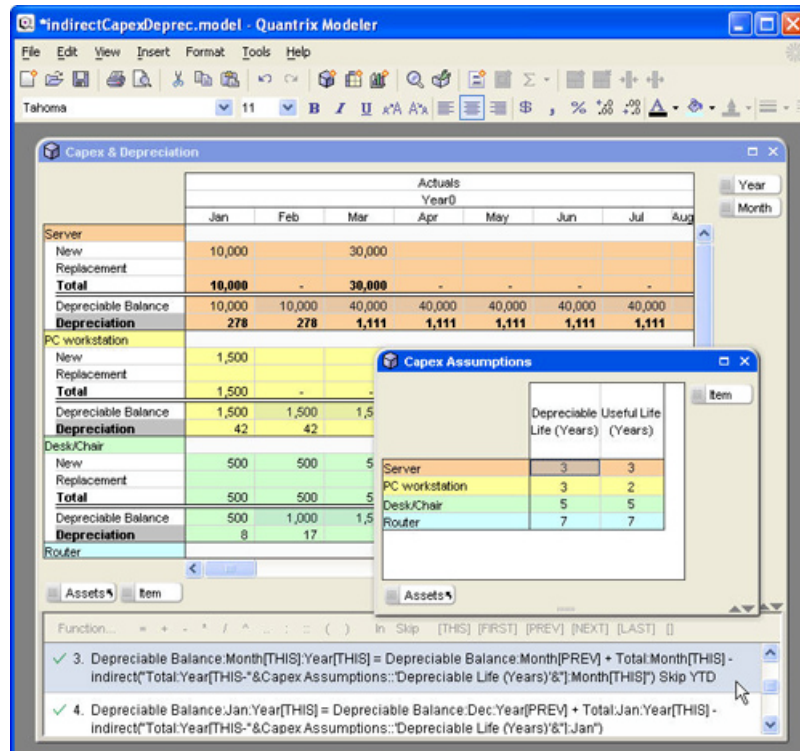
With spreadsheets and spreadsheet add-in, you can perform traditional what-if analysis on a limited set of representative scenarios (i.e. base, worst case, best case); other models and software components implement Monte Carlo simulation (examples: Palisade @RISK, Crystal Ball, Analycorp XLSim, and freeware such as SimulAr), accepting random variables as inputs

in order to compute the statistical distribution of target values. Other typical extensions draw on the rest of the toolbox provided by decision theory for applications in management, i.e. decision trees, constrained optimization, neural network, expert systems, etc. A survey of these extra features is beyond the scope of this document.

This software components assist the user in the configuration of the structure for financial simulations, providing tables for the definition of the chart of accounts, the format of statements and reports, the definition of the time horizon, the joint management of historical values – exogenous - and forecasted values - computed by the simulation engine. Predefined algorithms can be used in order to compute simulated values from assumptions about volume, price, growth, etc. (e.g. percentage growth rates, percentage of other values, manual input). Their main value resides in the conceptual model underpinning financial analysis, as they are mainly ancillary tools for providing consulting services. Their limit comes from the interactive nature of spreadsheets, based on two-dimensional tables where the presentation layout overlaps with the computing model, and hides its structure (see above considerations on my FINLAB model). Such features make spreadsheets excellent tools for rapidly creating a model tailored to a specific business case, but at the same time hinders their functionality for model auditing and documentation, model extension, multi-user support, performance in iterative processing of numerous instances. The building of a robust and user-friendly graphical user interface on top of a spreadsheet is also difficult because of the pervasive presence of the underlying set of tables, which makes navigation and control of the processing flow cumbersome. On the positive side, the market leader in spreadsheets, Excel, is an ubiquitous and mature product, providing effective support for report formatting and printing, a powerful macro programming language (VBA), support for add-in development (very useful for programming complex statistical and financial algorithms), database and web connectivity, data charting, only to name a few. It is not always the smart solution, but it can get always the job done, and for many use cases that is the priority.²

Second, we have **financial modeling software** marketed as an evolutionary leap from spreadsheets. The ancestors of this applications are modeling programming environments developed in the 70's and the 80's, even before the advent of the PC, such as IFPS and Optrans (such applications have in some cases evolved into expert systems shells, with varying fortune). These models allow explicit modeling of the business logic underpinning a financial simulation. They offer a rich data model based on time series (Javelin) and multidimensional arrays (Lotus Improv and its descendants, such as Quantrix Modeler, see <http://www.quantrix.com>). formulas for an entire model or for a part of it (a multidimensional matrix in Improv and in Quantrix) are managed separately from the table layout, and can be easily audited. Here is a screenshot from Quantrix modeler, showing the matrix view with the formula pane below):

² For a more detailed analysis of spreadsheets' limitations see the white paper by Peter Murray and Chris Houle of Quantrix (<http://www.quantrix.com/r-doc-2-2-70>) and also our paper 10-01-02 XBRL and Quantrix.



The formula language for financial modeling provided by these tools uses explicit variable names, instead of row / column coordinates³. Their user interface allows flexible representation of model data in different views, as can be done in multidimensional databases (such as Hyperion Essbase) or Excel pivot tables, but in this products the OLAP matrix is not only for data analysis and reporting, but is also the front end for data input and manipulation, and the heart of the computational engine⁴. Formulas can take projections of matrices as inputs or outputs, which makes them very concise and powerful. Adding new data to a matrix column does not require copying of the formula to the new cells. On the other hand, matrix notation imposes a steeper learning curve on the user: one has to figure out how the dimensionality of input arguments matches, and how this will affect the dimensionality of the output, which could be a matrix with the same dimensions as the larger input variable, a matrix with reduced dimensions, or a scalar. Interactive formula definition through pointing and clicking, the killer feature of spreadsheets, is simple for routine calculations, but in complex cases results cannot be taken for granted.

This tools are more pleasant to use than Excel. I have been a long time enthusiast of Javelin, and now I feel sympathetic with the attempt by Quantrix to pursue the visionary approach of Lotus Improv on an open Java-based platform. They are very good for simple business plans with multiple scenarios, provided that they have a straightforward business logic. Design and extension of such models, change of the time horizon, inclusion of additional scenarios, transformation of a constant value into a scenario dependent or time dependent variable require minor amendments to existing formulas and table views. They are also good at elementary statistical calculus (as is Excel). They share the interactive processing model of spreadsheets: you define formulas, assign inputs, recalculate, see the results. When one has to add procedural logic for workflow management, or more complex user interaction, this tools are limited. A

³ In traditional spreadsheets, use of named ranges is a surrogate for explicit variable names. However, as Excel power users know well, definition and maintenance of range names is weary and error prone.

⁴ Comparison between the hypercube model of OLAP databases and the sparse matrix design of Improv and the like is beyond the scope of this paper. It may be analyzed in a future research report.

macro language is absent or more limited than Excel's VBA. Quantrix can be extended with add-in modules written in Java, which requires adequate programming skills. They are client-oriented desktop applications, and are not designed to work as a computational server engine detached from its matrix-oriented user interface, that can be used by other client applications.

In conclusion, financial modeling software is too complicated to be proposed to the average end-user as a substitute for Excel. Both Javelin and Improv were greeted as killer applications in the press (Javelin won the award for most innovative spreadsheet package in 1987, outsmarting Microsoft Excel), but they failed to reach a critical mass and were dismissed after a few years. Despite this discouraging evidence, financial modeling packages have many of the features needed for designing the layout and the business logic of financial reports, they are much more powerful than spreadsheets or reporting tools for relational databases. For this reason they can be used in the client component of our platform. At the same time, their underlying multidimensional data model is probably the way to go for designing our shared financial data repository.

I have been doing some testing on Intersystems Caché, a so-called post-relational database that offers a multidimensional array data model, supporting a relational interface at the same time.

Third, we have **dynamic systems software**, originally developed for modeling engineering problems (e.g. electronic or hydraulic) and biological systems. There are numerous products in this category. As an example, we can mention Extend. Many of the most complex applications are unknown to the financial audience. There are also hybrid applications, sharing the features of dynamic system models and those of multidimensional financial modeling software: VenSim⁵, DecisionPro and Analytica are in this sub-category. These are the ideal tools for modeling the state of complex systems which evolves in time among discrete states in response to exogenous stimuli. They are characterized by a graphical programming environment, where one designs the process flow using components for resource flows, stores, processing stages, state dependent choices, definition of constraints, and so on. Typical example applications for these models are the dynamics of populations of predator and prey in an ecological system, or the programming of the flows of production and consumed resources in a processing plant. I have no direct experience of using these tools. My feeling is that they are overkill for basic financial planning, where spreadsheets and their descendants are more than adequate: financial planning is basically accounting plus some projection of forecasted values, discounting and statistical computation, so there is limited value added by a graphical user interface for designing and documenting the computing model. They are interesting tools in two respect:

- for modeling the supply / value chain underlying financial planning.
- for the interactive configuration and programming complex multi-company and multi-period processing flows, involving data acquisition and consolidation, transaction processing, closing procedure, advance to next period, etc.

In both cases, specific components must be developed, representing typical financial concepts and administrative procedures through software objects.

Fourth, we have **financial planning software**, i.e. solutions aimed at replacing spreadsheets by providing a more detailed data model and integration with accounting packages. An example is WinForecast, from the Australian vendor Sage (<http://www.winforecast.com.au/home.html>).

A list of solutions for financial forecasting can be found at:

⁵ Vensim is the tool used in a financial planning solution marketed in Italy by a network of business consultants under the brand B24B (Basel 2 for Business).

<http://www.financedownload.com/forecastingsoftware/forecastingsoftware.htm>

Fifth, we have the more articulate solutions, which combine and extend the capabilities of the previous categories, i.e. **software platforms for business performance management and strategic finance**. On top of accounting or ERP systems, multinational firms employ additional software components for financial planning and reporting or the so called “business performance management” (BPM), i.e. distributed systems enabling decision makers in every department of the company to participate in the planning process, and monitor the financial performance in real time, fostering immediate reaction to new opportunities and threats coming from the markets or from inside the firm. BPM software is a very complex (and expensive) replacement for spreadsheet models developed in-house that are the Swiss army knife normally used to do forecasts, simulations, and in general any kind of analysis and report that cannot be obtained from the accounting systems in a straightforward manner. BPM can be conceived as a “super-spreadsheet” software application modeling the value chain of a company, i.e. the processes linking financial results to key economic drivers (demand, input prices, efficiency, product prices, etc.). Such a solution avoids the problem and huge cost of converting and reconciling the data coming from the numerous spreadsheets used in the various departments into a central repository. In the usual setting, the office in charge of planning and management control has to gather sales forecasts from marketing, processing cost and inventory from production, input prices from purchasers, interest charges from finance, check the accuracy and standardize the format of the data, and finally feeding it in the centralized planning application. The BPM solution makes the planning cycle shorter and more accurate, and involves actors with the best knowledge in the timely provision of information that is immediately available to decision makers all over the business. Users of BPM systems interact with a central application which embodies the business model. Data is shared in real time thanks to network technology similar to that used for broadcasting market prices and position data in bank dealing rooms. Information is stored in a central database available as a data warehouse with OLAP functionality. Pioneers in the development and adoption of BPM systems are usually bigger corporations, or firms in the technology sector with very sophisticated IT solutions for managing their production chain in real time. Providers of this kind of software are either specialized vendors (Adaytum, Outlooksoft, Cognos), or providers of platforms for OLAP and information retrieval and multidimensional databases (Hyperion, more oriented towards financial consolidation and reporting). The big players in the ERP market are also entering these segment with offerings based upon their platform (e.g. the components for strategic and financial planning by SAP). The high cost and technological requirements of these solutions makes them unaffordable by small and medium sized firms.

3.2.2 Modeling the value chain of a business: our experiments

After this survey, I decided to take a hands-on approach, and defined a very simple case, a model with very few revenue and cost items. My aim was to compare different categories of tools, and in particular test the dynamic system, component oriented approach to modeling the value chain. Experiments have been carried on starting from June 2002. Work has proceeded in a unsystematic way, with exciting moments and pauses for reflection.

I decided to take a modular approach: a financial planning model should be decomposed into building blocks mapped onto business concepts. Such building blocks are assembled to represent the value chain of the business. The entities modeled in this setting were the following:

- resources purchased and transformed;
- output sold or disposed.

These items originate physical, economic and financial flows. The value chain is composed of **value nodes** connected by **flows**. Value nodes correspond to entities (external counterparts, or internal units) involved in the exchange and or physical processing of resources along the supply chain. Flows can be mapped onto **transactions**, such as purchases from suppliers and sales to customers. Following the well known Porter's model, boundaries are traced around internal units in order to represent an internal market where flows of resources are exchanged by means of internal transactions. Potentially, each value node can be represented as an independent company, with its own accounting system. In this way we can reach the finest granularity that is required, and the system is designed from the ground up to manage consolidated accounts. That is a key requirement, since our project is focused on firms' groupings (clusters and "distretti") where numerous independent companies form a cooperative supply chain. Consolidation of the financial statements for the entire cluster allows the assessment of the viability of the underlying business model, together with spotting inefficiencies in the distribution of the value created among cooperating firms.

Other key requirements were:

- adoption of an accounting model reconcilable with the detailed chart of accounts of firms, in order to allow joint reporting and comparison of forecasted and actual values on a homogenous basis;
- adequate treatment of multi-currency accounting, inventory, depreciable assets, taxes (several tributes in multiple jurisdictions) and other technical aspects.

On these grounding, our planning model is a sort of high level view of the accounting model underlying the "financials" module of a modern ERP system. So we have decided no to take the usual shortcut to the determination of the end result –the figures listed in financial reports - with a minimum computational effort. We wanted detailed and integrated financial accounts, with a Journal of transactions affecting income items and changes in assets and liabilities, and a General Ledger. This approach can be very powerful: forecasts can be combined with data extracted from actual accounts, you can obtain forecast also for the disclosure information required by accounting standards and by accurate models of cash flow statements. This approach may be complex and inefficient at the same time. In order to make it work, several challenges must be taken: a powerful computing environment is required; the user interface should hide the complexity to the end user; the system manager must be provided with friendly tools for configuring the business model and the chart of accounts; data interfaces with accounting systems have to be flexible and easy to configure, especially with regard to the mapping of the analytic chart of account with entities in the value chain model.

Our experiment has dealt with the simplest case: the current operations of a baker, purchasing flour, labor and energy and transforming them into fresh bread sold to customers and stale bread given for a few cents to a local rabbit farmer.

First experiments have been conducted in Excel and in Javelin. In June and July 2004 a prototype application has been developed on the Microsoft Visual Studio platform in the C# language. The business logic has been modeled in a set of C# classes. An elementary spreadsheet-like calculation engine has been developed on the grounds of a third party library, bcParser, which has been extended so as to be applicable to vectors and time series. No database interface is included. Small examples have been prepared in Excel using ManagedXLL, a third party library that allows a developer to package methods written in VB.net or C# as a compiled Excel add-in (in the XLL format).

The simple application does the following (hereafter some screenshots form the Excel interface are included):

- you configure the supply chain by defining a **product recipe**, in our case the physical relationship among inputs and outputs which are estimated as relevant in the production of bread (such assumptions can vary along the time horizon)

Data for product recipe quantity calculations

	enum	01/01/99	01/01/00	01/01/02	01/03/04	
bread	fixedQ	2	100	105	106	107
rabbitFood	fixedQ	5	5	3	0	0
flour	fixedQ	1	50	50	45	45
energy	fixedQ	4	12	11	9	9
labour	fixedQ	3	2	2	1	1
bread	varQratio	2	0	0	0	0
rabbitFood	varQratio	5	0,04	0,02	0	0
flour	varQratio	1	0,6	0,6	0,45	0,4
energy	varQratio	4	0,5	0,5	0,4	0,4
labour	varQratio	3	0,1	0,1	0,3	0,3

- then you define a set of actors involved in the supply chain: the suppliers (miller, energy provider and labour) and customers (bread consumer and rabbit farmer), interacting with the modeled business, i.e. the baker; this actors exchange *resources* along the supply chain

TEST MODEL OF BREAD PRODUCTION

bModel

name	<input type="text" value="mioModello"/>	getname	mioModello
handle	<input type="text" value="-0"/>	isAlive	VERO
priceList	MyPriceList 632563590522271863		

bNodes

name	productRecipe
breadConsumer	
baker	BreadProduction 632563590522271863
ENEL	
jobtime	
miller	
rabbitFarmer	

bFlows

name	resource	fromNode	toNode
consumedFlour	1	miller	baker
consumedEnergy	4	ENEL	baker
consumedLabour	3	jobtime	baker
soldBread	2	baker	breadConsumer
soldResidualBread	5	baker	rabbitFarmer

- the user defines assumptions for the model's *drivers*, i.e. volume (demand for bread) and prices over a given time horizon, divided into smaller reporting periods (quarters)

Recipitem unit prices		dates									
growth	enum	01/01/99	01/03/99	01/10/99	01/01/01	01/02/01	01/07/01	01/09/01	01/11/01	01/06/02	01/04/03
2,0% bread	2	2,00	2,04	2,08	2,12	2,16	2,21	2,25	2,30	2,34	2,39
0,5% rabbitFood	5	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
1,2% flour	1	0,87	0,88	0,89	0,90	0,91	0,92	0,93	0,95	0,96	0,97
2,0% energy	4	0,20	0,20	0,21	0,21	0,22	0,22	0,23	0,23	0,23	0,24
2,3% labour	3	1,50	1,53	1,57	1,61	1,64	1,68	1,72	1,76	1,80	1,84

Demand for bread (driver)												
dates	01/01/01	01/04/01	01/07/01	01/10/01	01/01/02	01/04/02	01/07/02	01/10/02	01/01/03	01/04/03	01/07/03	01/10/03
quantities	200	180	67	360	293,5	330,2	366,9	403,6	440,3	477	513,7	550,4

- the application simulates a marketplace where each actor places orders towards its suppliers. An event based matching procedure processes such orders, and generates compensating orders from suppliers based on the product recipe; matched orders are transformed into closed deals; deals are processed in the accounting systems of the aforementioned entities; each entity stores accounting data in two data containers: the *hyperJournal*, i.e. a journal of the processed deals integrated with information needed for multicurrency accounting and other specialized data processing (e.g. inventory accounting), and a *hyperLedger*, i.e. a

general ledger using a simple chart of accounts, and capable of calculating accounting figures in several reference currencies on a multi-period horizon.

HyperJournal for bnode		baker	lastInstance baker.HJournal 632563590514360329				
Dates	prog	trType	tradable	price	Tcy	quantity	
01/01/01	1	1	1	0,901697	1	107	
01/01/01	2	1	3	1,605899	1	11,5	
01/01/01	3	1	4	0,212242	1	58,5	
01/01/01	4	2	5	0,101508	1	-4,9	
01/01/01	5	2	2	2,122416	1	-200	
01/04/01	6	1	1	0,912518	1	95	

ChartOfAccounts.Show()

accountId	accountDescr	actgNature	actgSubNatur	funcArea
10010	Prodotti c/vendita	1	101	1
10020	Materie prime c/acquisti	1	100	1
10030	Costo del lavoro	1	100	1
10040	Costo per servizi	1	100	1
10050	Scarti lavorazione c/vendita	1	101	1

HyperLedger bNode baker (from hj works only with baker)

name MyLedger
 id 1
 handle -0 isAlive VERO

InputData

ClosingDates

31-dic-00	31-dic-01	31-dic-02	31-dic-03	31-dic-04

refCurrency 2 USD

DetailedLedger.Show

chartAccoun	accountId	bNodeName	resource	localCur
1	10020	baker	1	1
1	10030	baker	3	1
1	10040	baker	4	1
1	10050	baker	5	1
1	10010	baker	2	1

Dates	accountId				
	AC10020	AC10030	AC10040	AC10050	AC10010
31/12/00	0,00	0,00	0,00	0,00	0,00
31/12/01	-189,71	-47,28	-31,19	0,83	810,84
31/12/02	-171,25	-162,44	-30,00	0,00	945,76
31/12/03	-237,29	-247,24	-44,64	0,00	1315,56
31/12/04	-272,25	-327,75	-58,58	0,00	1666,44
31/12/05	-329,13	-408,81	-72,61	0,00	2017,32
31/12/06	-343,35	-429,07	-76,12	0,00	2105,04

The prototype does not manages inventory accounting and depreciable assets, taxes, interest and extraordinary items.

The effort required has been substantial, given that a lot of time has been absorbed in the evaluation of software development tools. What has been conceived is a simplified version of a platform for business performance management, and the consequent steep learning curve and slow progress is no surprise. In the future steps of this WP care must be taken in finding a more effective path leading to solutions immediately applicable to real cases. The development of the financial accounting engine may be left to a later stage, after verification of the gaps in the existing solutions used by small firms.

3.3 XBRL [WP1 1]

One of the XBRL front our group has done a substantial amount of work, and has reached a good visibility in Italy. The team working on this issue is composed by Davide Panizzolo, a post-doc at DISA with a background in Mathematics, and by myself.

First of all, a primer on the XBRL language, and its applications, has been published with help from Walter Aste, then a graduating student at our faculty (Aste W., Panizzolo D.; “Lo standard XBRL (eXtensible Business Reporting Language) e la comunicazione finanziaria d’impresa”, *Alea Tech Reports*, n. 20, maggio, downloadable from <http://smefin.net>). Such publication has been for several months the only material about XBRL available in the Italian language. In April 2005, the Italian Bankers’ Association (ABI) has organized a conference on XBRL in Rome. I have been invited to give a presentation on XBRL and SME financing.

On the IT side, Davide and I have developed some prototypes and databases supporting the typical activities in the processing of financial information through XBRL. The components obtained are the following:

- an Excel model for automating the definition and generation of XBRL taxonomies;
- a SQL server database, with an Access front end, mapping XBRL taxonomies and instance data (i.e. data in a specific financial statement) on a relational data model; such database should be used as a repository for datasets of accounting reports; a test has been conducted on a sample of 200 balance sheets taken from the Bureau Van Dijk’s AIDA database;
- a web front end for instance data manipulation, developed with the Authentic pug in by Altova, an ActiveX component for editing XML documents in Microsoft Internet Explorer.

We are now working in a voluntary group promoted by ourselves with support from InfoCamere, the IT company of the Italian Chambers of Commerce Network. The goal of the group is to produce a taxonomy conformant to nowadays Italian accounting regulations (the most popular XBRL taxonomy is the one implementing IAS-IFRS, i.e. financial reporting standards issued by the International Accounting Standards Board). For this work we are using the Excel model mentioned before.

As can be seen, we have done significant advances in the activities contemplated in the FIRB program before the official start of the project.

3.4 IAS [WP12]

This is a relatively autonomous work package. In this domain, I have asked Michele Bertoni, researcher of accounting at DISA, to write a short survey paper, published in the DISA’s series, on the agenda for the introduction of International Accounting Standards in Italy, and its impact on small and medium enterprises (Bertoni, M. (2005), “L’evoluzione della normativa in materia di bilancio e le prospettive di applicazione dei principi contabili internazionali alle piccole e medie imprese”, *DISA, Dipartimento di Informatica e Studi Aziendali, Università di Trento, Quaderni*, Trento, n. 103). Michele has also assisted some graduating students in their thesis work on, and is the leading expert on technical questions relating to measurement and disclosure issues.

The main finding of this survey is that the additional disclosure and new criteria introduced with IAS will drive the demand for competence and applications related to mandatory financial reporting, financial communication and internal reporting on risk management, financial instruments, and other specialized topics.

4 - Milestones and project plan

The approved FIRB program includes the following plan of activities:

10-Financial objects

01 01 Requirement analysis

DR

Workpackages		1	6	12	18	24	30	36
WP09 Tagliavini	Financial planning models	1	1	1	1	1	1	1
WP10 Erzegovesi	Financial objects			1	1	1	1	1
WP11 Giorgini	XBRL			1	1	1	1	1
WP12 Zavani	IAS	1	1	1	1	1	1	1

The first year of activity is focused on analysis and production of a model for financial planning, implemented on a spreadsheet or with more sophisticated end-user tools.

I suggest to anticipate the activity on XBRL, which could be used straight away as the language of choice for defining the structure and the content of the financial reporting schemes endorsed by ourselves. XBRL supports the definition of reclassified reports, ratios, cash flow statements. With some extension it can be used in order to represent the business logic of models for financial simulation. Using XBRL would ensure a common representation of concepts, together with a more tech oriented approach, preventing a proliferation of partial spreadsheet solutions.

The activity on financial objects can safely start from the second year. Meanwhile, we could go on with experiments some IT components, select the software platform, and hire and train the software developers.

5 - How to start

I propose to start the activities of WP's 9 to 12 in a meeting devoted to the discussion of this document. Preliminary exchange of ideas can start immediately by phone or e-mail, or in one to one informal meetings. I would like to have a brain storming session which should produce a revised project plan with a clear and shared division of work.