Universität-Gesamthochschule Paderborn

Fachbereich Wirtschaftswissenschaften

Diplomarbeit

From Performance Measurement to Balanced Scorecard

OLAP and Groupware as the underlying technologies
in a modern Balanced Scorecard solution

Vorgelegt bei:

Prof. Dr. Ludwig Nastansky

Sommersemester 2001

Patrick Söhlke

Studiengang: Wirtschaftswissenschaften (BWL)

Matrikel-Nr.: 3284193

Bürgermeister-Söhlke-Str. 22

31840 Hessisch Oldendorf

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Abbreviations

ADBS	Action-driven Balanced Scorecard
ACL	Access Control List
Admin	Administrator
BI	Business Intelligence
BSC	Balanced Scorecard
CSF	Critical Success Factor
CSCW	Computer Supported Collaborative Work
DBMS	Database Management Systems
DECS	Domino Enterprise Connection Services
DSS	Decision Support System
DW	Data Warehouse
e.g.	exempli gratia (for example)
ERP	Enterprise Resource Planning
ETL	Extraction, Transformation and Loading
HOLAP	Hybrid OLAP
ID	Identification
i.e.	id est (that is)
IT	Information Technology
KM	Knowledge Management
KPI	Key Performance Indicator
KVD	Key Value Drivers
LAN	Local Area Network
MAT	Moving Annual Totals
MIS	Management Information System
MOLAP	Multidimensional OLAP
MQL	Multidimensional Query Language
NAB	Name and Address Book
OLAP	Online Analytical Processing
Org	Organizational / Organization
PM	Performance Management
RDBMS	Relational Database Management Systems
ROCE	Return on Capital Employed

ROI	Return on Investment
ROLAP	Relational OLAP
SQL	Structured Query Language
WAN	Wide Area Network

1. Introduction

1.1 Scenario

In order to delimit the general concepts and approaches that were incorporated into this paper, the following chapter gives a brief introduction of the current economical and technological aspects, trends and relevant factors that lay the foundations for this work.

1.1.1 Competition at the end of the 20th century

The beginning of the information age in the late 1970's did not only produce sensational new opportunities in the area of information technology; it transformed the fundamental conditions and circumstances in the competition between organizations.

Mass production has been the critical success factor in the industrial age (1850 – 1975). Only those organizations became successful which were able to transform new technologies into material assets to guarantee an efficient production of standardized products.
Financial controlling systems were established by many large organizations, which allowed them to allocate financial and material assets in a more efficient way.

Return on Capital Employed (ROCE) as the leading financial indicator enabled organizations to use its capital in a more productive way and at the same time to measure the efficiency of various business areas.
With the dawn of the information age, however, it was no longer possible to compete in a permanently changing environment only by managing one's financial assets and liabilities.
The utilization and mobilization of existing resources became more important than the investment into new resources.

Today's success of organizations in their markets relies heavily on innovation and fast reaction to market changes.[1]

1.1.2 New challenges

In 1992 Professor Robert Kaplan and Dr. David Norton introduced a system and methods for translating strategy into action by effectively using people's abilities, energies, and knowledge: The Balanced Scorecard.
They revealed six areas in which organizations need to take action in order to improve or maintain a competitive position.

- **Working across functional areas**
  Specialization in the industrial age was necessary to gain significant competitive advantages over competitors in a marketplace. In modern organizations, however, the concept of integrated business processes closes the gap between various functional areas and combines excellence through specialization with efficiency and quality.

- **Relationship to customers and suppliers**
  Information technology today allows organizations to integrate processes with their suppliers and customers. This way, all activities are trigged through a customer order instead of a production plan.

- **Customer segmentation**
  Low-cost standardized products and services were successful in the industrial age. Customers were not in a position to demand customized solutions.
  This has changed completely. The demand for individualized solutions nowadays drive organizations to offer products and services in different market segments.

- **Globalization**
  Competition is no longer limited to national boundaries; today's organizations are faced with the most efficient and experienced international competitors. The

[1] See (Kaplan et al., 1999, p. 2).

challenge is to coordinate global activities and local presence.

- **Innovation**

  A company cannot take a rest on yesterday's success since it does not guarantee that a product will be successful tomorrow. Anticipation of future customer needs and a culture of innovation are the key success drivers in all sectors that are subject to fast technological changes.

- **Participation of people**

  The most important resource of an organization is its people. Analytical capabilities and participation in the ongoing process of product and service improvement have become more important than pure task execution.
  People contribute to the organization's success; investment into their knowledge and training is a critical success factor for state of the art enterprises.[2]

The term Knowledge Management is often used in the context of people and will be explained in more detail in the third chapter.
In order to be successful in a marketplace organizations need to compete for the best human resources. [3]
Various incentive programs have been brought into being to attract potential employees. However, even with the best human resources in place an organization will fail when it is not able to adjust fast enough to market changes.

1.1.3 The Need for Performance Management

The previous paragraph describes the need for today's organizations to do business in a much different way than half a century ago. There are numerous opportunities and challenges.
The Information Technology and the rise of the Internet have transformed the role of people in businesses from simple "doers" into "implementers". Business processes do not only have to be operated; the ongoing transformation and automation within

[2] See (Kaplan et al., 1999, p. 3-5).
[3] See (Morel Fourman et al., 2000, p. 7).

organizations goes hand in hand with an increased need for measurement and management of these processes in order to improve quality and performance. Performance management closes the gap between data in the business process and the people that need to take actions. It allows an organization to be more efficient and helps people to use their intelligence to make the right decisions.[4]

1.2 Objective, methodical procedure and delimitation

1.2.1 Objective

The main objective of the thesis project described in this paper was the development of a modern organization-wide available Balanced Scorecard application. The here in described 'Action-driven Balanced Scorecard' system incorporates basic economic concepts, a combination of different methodical approaches and an amalgamation of state-of-the art technologies as a tangible result.
According to the defined objective, the Action-driven Balanced Scorecard is a Groupware-based information and communication system, which supports managers in dependably delivering on strategy, in effectively managing organizational performance and in acting on the visible deviations of defined key performance indicator by means of action management.
The ADBS system consists of a combination of specifically designed application components, which allow a complete conversion of the Balanced Scorecard concept into a single system and add further complementary functionality.
This work mainly focuses on the ADBS system itself and additionally explains the underlying technologies and economic approaches.
The following chapters give an introduction of the basic framework, explain the relevant methodical and systematical concepts and describe the underlying information and architecture models as well as the general system design.

1.2.2 Procedure

The preceding introduction briefly summarizes the new challenges and growing competition organizations are faced with at the beginning of the new millennium.

[4] See (Morel Fourman et al., 2000, p. 8).

Accordingly, the need for sophisticated application systems that allow organization to efficiently manage performance and use their existing resources is further described in the second main chapter.
Accounting, an Anglo-Saxon term which is similar but not exactly equal to the German term ‘Controlling’, Performance Management and the concept of Balanced Scorecard are described in detail in the second chapter and thus lay the economic foundation for the ADBS system.
The Arthur Andersen Business Consulting Best Practice Study is a further source of information to this work and adds practical economic basics to the underlying business concepts.
The third main chapter starts with a brief introduction of the terms data, information and knowledge and gives a more detailed explanation on the core concepts of data warehousing, relational databases and OLAP technology, which is a key component of the ADBS system technology.
Furthermore, it explains Groupware as the underlying technological infrastructure for distributed application systems.
The fourth chapter contains the main part of this work. It begins with a broad overview on the ADBS system architecture and concept and explains the core structural elements and the general system design in more detail. The first section also contains a description of the underlying information model and its key elements as well as a detailed look at the architecture model.
The second part thoroughly describes the individual structural elements and explains the design and the functionality of the ADBS system.
A final conclusion summarizes the entire contents of this work and ends with a brief valuation of the system followed by a short outlook on future activities.

2. Accounting, Performance Management, Balanced Scorecard

The first general chapter of this work provides the basic framework of fundamental economic principles, common accounting practices and applied approaches which lay the foundation for the conceptual design and development of the information model and solution architecture described in the fourth chapter.
It is divided into two major parts and starts with the definition and explanation of the terminology used throughout the following chapters.
The second part will then introduce and explain the terms Performance Management and Balanced Scorecard as described by Kaplan and Norton.

Finally, this chapter concludes with a short summary of the transition from traditional economic concepts, which mainly focus on financial information to the application of financial and non-financial indicators in the controlling of state-of-the-art organizations.

2.1 Traditional Accounting Systems

2.1.1 Definition for Accounting

"Accounting is a service activity. Its function is to provide quantitative information, primarily financial in nature, about economic entities that is intended to be useful in making economic decisions – in making reasoned choices among alternatives."[5]
In other words accounting is the process of identifying, measuring and communicating economic information to allow users to take relevant and informed decisions.[6]
Accounting information can be divided into three categories:

Operating information is raw quantitative data which is needed to run an organisation and which is the input to both financial and managerial accounting.

[5] See (http://cbpa.louisville.edu/karcher/Chapter%201/sld003.htm).
[6] See (http://management.canberra.edu.au/lectures/accounting/sem981/unit4220/lecture1/sld002.htm).

Financial accounting information is provided for external decision-makers and needed for current and potential creditors or investors and government agencies. It is mostly broad and general purpose in nature.

Management accounting information in contrast is provided for internal decision-makers for all levels of responsibility as the company's management, its employees and its board of directors.[7]

Most management decisions rely on financial information. Financial reporting is needed to take the investment and credit decisions and to assess future cash flows. It is, however, also used to assess enterprise resources before actually claiming and changing them.

The concept of Balanced Scorecard also identifies financial information as most critical for organizations but it extends this one-sided view to non-financial information also.

2.2 Balanced Scorecard and Performance Management

Financial reporting is still deeply embedded into account systems that were developed centuries ago for small transactions between independent organizations and were focused on tangible assets only.

In the New Economy, however, intangible assets have become even more important. Various economic activities as partnering, co-operations and alliances do not fit into these accounting practices anymore since they involve more than one organization and also embrace intangible assets.

Today it is more likely that companies agree to cooperate in research and development in a particular area of activity to share costs, combine resources and get faster results but remain competitors in other market segments.

Ideally, the traditional accounting systems could have been extended to include the valuation of these intangible assets.

However, the difficulty in the valuation of intangible assets as new products, customer satisfaction, know-how, IT infrastructure or employee motivation, made it impossible for most companies to include these assets into conventional financial statements. [8]

[7] See (http://management.canberra.edu.au/lectures/accounting/sem981/unit4220/lecture1/sld003.htm).
[8] See (Kaplan et al., 1999, p. 7).

2.2.1 Balanced Scorecard – a short explanation

The Balanced Scorecard extends traditional measures of past financial performance with a set of drivers of past, present and future financial and non-financial performance. It provides an overview of an organization's overall performance by integrating financial measures with key performance indicators around four perspectives:

- Financial Perspective
- Customer Perspective
- Internal Business Processes Perspective
- Organizational Growth, Learning and Innovation Perspective

Each perspective is measured by a specific set of key performance indicators. The financial and the customer perspective include external measures whereas the internal business processes perspective and the organizational growth, learning and innovation perspective focus on internal measures; thus it is possible to *balance* the number of internal and external key performance indicators.
The vision and strategy of an organization are both translated into financial and non-financial measures to communicate the strategic intent to all levels of responsibility and to track performance against established strategic goals.
This way all members of an organization will become familiar with the consequences and impacts of actions and decisions they have taken while the organization’s management will be aware of the driving forces behind sustained long-term success.

Perspective	**Critical Success Factor**	**Key Performance Indicator**
Financial	Financial Position	Sales By Product
Customer	Customer Satisfaction	Returned Products

Table 2-1 - Strategy translation into measures (key performance indicators)

2.2.2 Performance Management – a short explanation

Throughout the 1980s and the beginning of the 1990s organizations began to implement Enterprise Resource Planing (ERP) systems like SAP, Baan, Oracle or Peoplesoft. The term ERP summarizes a wide range of activities based on multi-module application software which helps organizations to automate and partly manage their business processes, including product planning, parts purchasing, maintaining inventories, interacting with suppliers, providing customer service, and tracking orders. Typically, an ERP system is based on a relational database system, which will be explained in the next chapter.[9]

Nowadays, there is a major shift towards continuously improving systems by supporting people to understand the business and manage it better. Performance Management is at the center of continuous improvement.

While the automation of business processes has almost been completed in most organizations, tools and systems that measure and manage these processes in order to maintain quality and to improve performance still need to be taken into consideration.

Data in the process is delivered to people that are responsible for taking actions and thus will be enabled to work more effectively.

In every organization accounting and enterprise resource planing systems are essential to *do* operational business, while performance management systems are vital to *manage and improve* the achievement of strategic objectives and goals. [10]

In their global best-practice benchmark study, Arthur Andersen Business Consulting identified the performance management habits of high performing organizations, which will be explained in detail later in this chapter.[11]

The most important result of the Arthur Andersen study is illustrated in figure 2.1. The fact of *having* a vision only partly contributes to an organization's overall success; in order to create a high performing organization a company needs also to have the ability to *implement* and to deliver on its strategy.

[9] See (whatis.techtarget.com/WhatIs_Definition_Page/0,4152,213946,00.html).
[10] See (Morel Fourman et al., 2000, p. 16).
[11] See (Morel Fourman et al., 2000, p. 11).

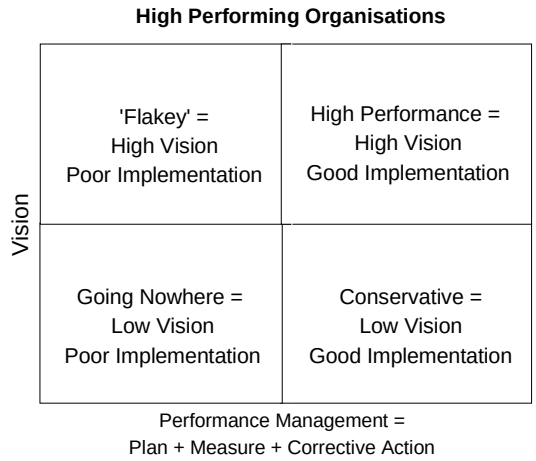


Figure 2-1 - The characteristics of high performing organizations

Organizations need to develop strategic plans, set targets and track performance to ensure that objectives are met.

To implement strategy and to measure performance is only the first step to high performance, more important is to turn strategy into activities that achieve specific strategic goals.

Therefore passive performance measurement needs to be replaced by action- and result-oriented performance management.[12]

Most organizations in the Arthur Andersen global benchmark study recognized that a well-established performance management process is key to their success. With this process in place these organizations have a better knowledge of internal and external circumstances and are even better prepared than others to adapt to the rapid changes in the New Economy.

2.2.3 Performance Management in five steps

The performance management process of high-performing organizations can be divided into five steps that result in the creation of business value.

Strategy Development

Strategic action plans are the vital part of the performance management process. They include the creation of key value drivers and strategic goals that lead to significant competitive advantages.

[12] See (Morel Fourman et al., 2000, p. 17).

Target Setting

At the operational level action plans focus on the continuous improvement of the key value drivers, on the utilization of existing resources and on setting targets for future periods.

Performance Measurement

Data from various data sources needs to be collected, processed (including data consolidation and modeling, see value creation cycle in chapter 3) and distributed in order to support step 1 and 2.

Performance Review

Actual performance, target and forecast values need to be continuously reviewed so that corrective, preventative and breakthrough actions can be taken to keep an organization on track.

Incentive Compensation

The effects of the various actions are linked to compensation and benefits initiatives to make sure that people also profit from the company's success.[13]

2.2.4 The habits of high-performing organizations

The Arthur Andersen study focused on identifying re-usable best practice in the performance management process. The outcome was a clear result of certain common performance management 'Habits' that enable organizations to implement their vision by continuously learning and improving.[14]

- **Habit 1: Deliver on the strategy and goals**
  Strategic goals at the top level need to be translated into critical success factors and key performance indicators. Financial and non-financial indicators are combined in a Balanced Scorecard to measure and monitor performance.
- **Habit 2: Create and manage internal partnership**
  People in an organization need to know what they need to do. An effective implementation of the company's strategy can only be achieved if people work together in a team. Vision, drive and enthusiasm support internal partnership on its way to shared strategic goals.

[13] See (Morel Fourman et al., 2000, pp. 17-18).
[14] See (Morel Fourman et al., 2000, p. 21).

- **Habit 3: Keep it simple**

  Important *information* needs to be separated from less important *data*. A small number of key value drivers focus on what is important and make it easier to measure and monitor performance and results.

- **Habit 4: Manage by exception**

  Effective management is based on the understanding of what is happening inside and outside the company. Exception reporting focuses the attention of managers on the performance that is outside the range of an expected target and thus supplies the information managers need to take actions.

- **Habit 5: Manage by action**

  Performance measurement is a passive process, which does not include the addition of value to existing information. Managers therefore need to turn the results and the subsequent analysis of the defined measures into concrete actions that resolve problems.[15]

  Corrective actions can help to overcome existing problems while preventative actions are used to resolve forecasted problems before they actually happen. The third type of action, breakthrough actions, takes advantage of new opportunities and challenges and focus on producing results that are beyond expectation.

  The most important aspect of actions, however, is that they need to be reported, tracked and managed in order to create a culture of openness, transparency and continuous self-improvement.[16]

- **Habit 6: Create information transparency**

  Gathering, delivery and presentation of information needs to be automated so that attention can be focused on the analysis and understanding of what happens in the organization. All members of an organization should subsequently be able to access the performance management knowledge with the limitation that they only see those parts that they need and are allowed to see.[17]

  Performance Management of that kind gathers company wide information from multiple sources and delivers it to the relevant distributed users.[18]

[15] See (Morel Fourman et al., 2000, p. 22).
[16] See (Morel Fourman et al., 2000, pp. 109).
[17] See (Morel Fourman et al., 2000, p. 22).
[18] See (Morel Fourman et al., 2000, pp. 119).

- **Habit 7: Leverage technology**

  The preceding Habits summarize the key business needs for organizations to be successful in the New Economy. Information technology is required to implement and deliver these Habits and to achieve high performance.[19]

  Instead of removing existing Business Intelligence tools and IT infrastructure, the leverage of established information systems is a much more effective way to drive the success of the performance management process.

  A performance management solution requires *communication, collaboration* and *coordination* as well as flexible security based on the organization's underlying structure.[20]

2.3 Conclusion

The transition from traditional financial accounting system and performance measurement towards Balanced Scorecard and performance management already takes place in organizations. As an ongoing process it naturally demands continuous development and improvement as well as the participation of people in the organization. The concept of Balanced Scorecard has an organization-wide focus, and therefore cannot be implemented without the backing of the top management *and* organizational members from all hierarchical levels.

Its main objective is not to gain total control over all company assets and resources but to guarantee the best possible performance based on an organization's strategy and its people.

Modern application systems as the Action-driven Balanced Scorecard need to incorporate the most innovative and most current technologies in order to provide state-of-the-art functionality. In the case of the ADBS system, the combination of two leading technologies, OLAP and Groupware, allows the entire conversion of the Balanced Scorecard concept into a tangible information and communication system. The following chapter gives a detailed overview and a final valuation of these very different technologies, which form the ADBS system.

[19] See (Morel Fourman et al., 2000, p. 22).
[20] See (Morel Fourman et al., 2000, pp. 135).

3. Information technology and communications

Information technology, information management or IT, the terms are often used synonymously, are important to every small, medium or large-scale business. Taking up the seventh of the performance management 'Habits' of the preceding chapter, information technology also lays the foundation for performance management as it is described above.
Therefore the third part of this paper provides a short terminological delimitation of the terms data, information, information technology and knowledge. Furthermore, it introduces and explains the basic technological concepts applied in the presented solution.

Various definitions of data and information exist in the scientific literature. The next paragraph will hence give an overview on the large variety of definitions and will conclude with a basic definition and description of the relations between the terms.

A general definition of information can be found in Webster's New Encyclopedic Dictionary, where it is defined as

- " …the communication or reception of knowledge or intelligence…"
- "…knowledge obtained from investigation, study, or introduction…"
- "…knowledge of a particular event or situation…"
- "…fact, data…"
- "…a signal or mark put into or put out by a computing machine…"

The following chapter will abstract from this general definition of the terms data, information and knowledge, and will focus on a more technological and precise definition.

3.1 Data, Information, Information Technology, Knowledge

Several online encyclopedias put the term data and information already into a much more technological context. www.techweb.com/encyclopedia describes information as

"Stimuli that has meaning in some context for its receiver. Information can be converted into data and can be passed on to another receiver, which is done by putting it into the computer where it is stored and processed as data, and then put out as data in some form that can be perceived as information.
The summarization of data. Technically, data are raw facts and figures that are processed into information, such as summaries and totals. But since information can also be raw data for the next job or person, the two terms cannot be precisely defined. Both terms are used synonymously and interchangeably."

A variety of definitions can be found for the term data.
"In computing, data is information that has been translated into a form that is more convenient to move or process. Relative to today's computers and transmission media, data is information converted into binary or digital form…" or "…generally and in science, data is a gathered body of facts. "[21]
Data is also explained as "…distinct pieces of information, usually formatted in a special way".[22]
The term information technology "…generally relates to all facets of managing and processing information and includes all forms of technology used to create, store, exchange and use information in its various forms, especially within large organizations."[23]

The last remaining term to be explained in this chapter is knowledge.
"In information technology, knowledge is (…) the possession of information or the ability to quickly locate it." In the business context it is also described as

[21] See (whatis.techtarget.com/WhatIs_Definition_Page/0,4152,213946,00.html).
[22] See (http://aol.pcwebopedia.com/TERM/d/DATA.html).
[23] See (http://aol.pcwebopedia.com/TERM/l/IT.html).

"…possession of experienced 'know-how' as well as possession of factual information or where to get it".[24]

3.2 Value Creation Cycle

The following paragraph explains how the above-described terms are used throughout this work by describing the transformation process of an organization, which turns data into business value. The interconnection of the terms is explained in Figure 3.1, which illustrates the process by which data is turned into Business Value.

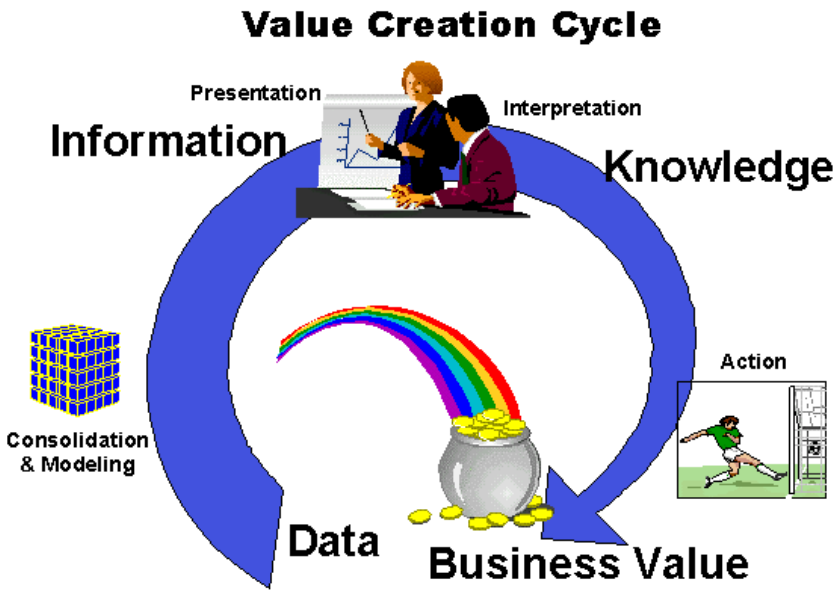


Figure 3-1 - Value Creation Cycle

The first step of the transformation process is the identification of all relevant data sources in an organization. From there, raw quantitative data is extracted and used to create information by consolidation and modeling. For example, business measures like Return on Investment (ROI) is created from raw financial data. This technology will be explained in more detail in the next paragraph.
Knowledge is created from information through application and through the addition of interpretation, in other words knowledge is information that is brought into a specific context.

[24] See (whatis.techtarget.com/WhatIs_Definition_Page/0,4152,213946,00.html).

Simple performance measurement would stop at this stage. However, passive measurement would not include the addition of value to existing information. Performance management as described in the second chapter allows people to make this process active. People take action based on Knowledge. Business Value is only created when people take action and actually make use of their knowledge.

3.3 From Data Warehousing to OLAP

3.3.1 Managing information today

The first chapter describes the impacts of globalization and increasing competition between organizations, which drive the need for complex analysis of business data. At the same time, the amount of information in organizations is growing to an extent that cannot be overlooked anymore without the use of sophisticated software tools. A well-designed information system needs to be put in place to cope with these challenges. New applications need to be able to do the following:

- provide multidimensional views of existing data,
- process many different data formats,
- define and consolidate various data models,
- link to standard applications and
- create flexible and easy-to-handle reports.[25]

3.3.2 Data Warehouse

In the 1970s and the 1980s, organizations made major investment into computer equipment that performed basic data processing and data storage operations.
As a logical consequence, throughout the 1990s and today, substantial investment is made around information systems that add value to the available data.
The main buzzword in this context is “Data Warehouse”.
A Data Warehouse is a collection of data from various data sources, which is made available to non-technical end users. Raw data is transferred into business information and can be set into an organizational context. Specialized tools transform the heterogeneous data into comprehensive and easy to overlook information.[26]

[25] See (Helmut Reinke et al, 1999, p. 24).
[26] See (Stefan Ekrich et al., 1998, p.1).

The information is thus made available for further analysis and reports.
The center of each Data Warehouse is a specially designed database, in which data that is needed for planning and decision-making is aggregated in a particular way. Hence, data is stored twice, which is avoided in normal information systems. However, this so-called data redundancy has three considerable advantages:
Operational data needed e.g. in the production process is separated from data, which is used in analysis and reports. Access to productive information systems is consequently reduced.
End users have more room to move since data supplied via a Data Warehouse can be independently modified, aggregated and stored.
The additional database also allows for more efficient control and supervision of the flow of information between end users and the Data Warehouse.
The data stored in the underlying database is not structured according to the laws of application programming but according to existing interrelations in business.[27]

3.3.3 Data Marts

Building a company-wide Data Warehouse can be very costly and time-consuming. Few organizations can afford to invest into the establishment of an entire Data Warehouse.
Therefore, nowadays Data Marts, which can be created in a relatively short amount of time and at comparatively low costs, are put in place instead.
Data Marts can be described as small Data Warehouses that are specially designed for departments. They are much easier to implement and can be dynamically adapted to the specific needs of departments. In general, Data Marts represent a fraction of the organizational reality, e.g. sales information, analysis of the production process or investment planning. Combined, a set of Data Marts can be much more efficient than a large Data Warehouse for the entire organization.[28]
The most difficult task when establishing and getting data into a Data Warehouse is the process of extraction, transformation and loading (ETL). In the case of large organizations, it is nearly impossible to model and structure all relevant data across the organization in the same way. Furthermore existing tools for the extraction of

[27] See (Helmut Reinke et al, 1999, p. 29).
[28] See (Helmut Reinke et al, 1999, p. 39-40).

data from heterogeneous data sources and for the subsequent transformation into a central Data Warehouse database are often not very easy to handle. Especially, when the complex organizational client/server architecture has to be administrated and securely managed at the same time.

As it stands today, there is a major trend heading away from large, company-wide Data Warehouses towards easy-to-overlook Data Marts, which more efficiently help to meet the information requirements of organizations.[29]

3.3.4 Data Mining

Data Marts and Data Warehouses provide an underlying infrastructure, which makes data available to users for further analysis and reporting. For a single user, however, relationships between different data items are not visible on the first glance. As a consequence a substantial amount of information in organizations is lost or not recognized.

Therefore, the localization of valuable information in databases is an important process for which the methods of data mining are most suitable.

There are two distinct ways to find important relationships:

- to search the entire collection of available data or
- to make spot checks to locate valuable information.

Data Mining is only one aspect of Knowledge Discovery in databases, which includes data preparation, data selection and data clearing.

Data Mining can be subdivided into five areas of activity:

- Data selection
- Data transformation
- Data Mining in the narrow sense (e.g. forecasting and classification models, link analysis and database segmentation)
- Interpretation
- Presentation of produced results

The following paragraph will provide a detailed overview of the most commonly used Data Mining technology – OLAP.[30]

[29] See (Helmut Reinke et al, p. 41-42).
[30] See (Helmut Reinke et al, p. 42-44).

3.3.5 Relational Database Management Systems and OLAP

As described in the paragraph above, most Data Warehouses are built around a relational database, which centrally stores extracted and transformed data from various data sources. Even though Data Warehouses are created for end users, most information is not easily searchable. On the one hand, end users do not sufficiently understand the underlying data structures. On the other hand frequently asked questions (like "Who are the top sales managers of each region last year, sorted by month?") have to be formulated in SQL, the relational query language, which is quite complicated. Furthermore, the usage of dynamic (interactive) queries is nearly impossible. More advanced query tools are much better suited to address this kind of query. OLAP is one example. While the underlying database hides the complexity of the data structures from the end user, access is provided to multidimensional data instead or in addition to relational data.

The term OLAP (OnLine Analytical Processing) has become almost synonymous with multidimensional databases and differs substantially from the classic relational database management system (RDBMS).

3.3.5.1 RDBMS

Traditional databases were organized by fields, records and files. According to the terminology, a field is a single piece of information; a record is one complete set of fields; and a file is a collection of records. (Figure 3.2)

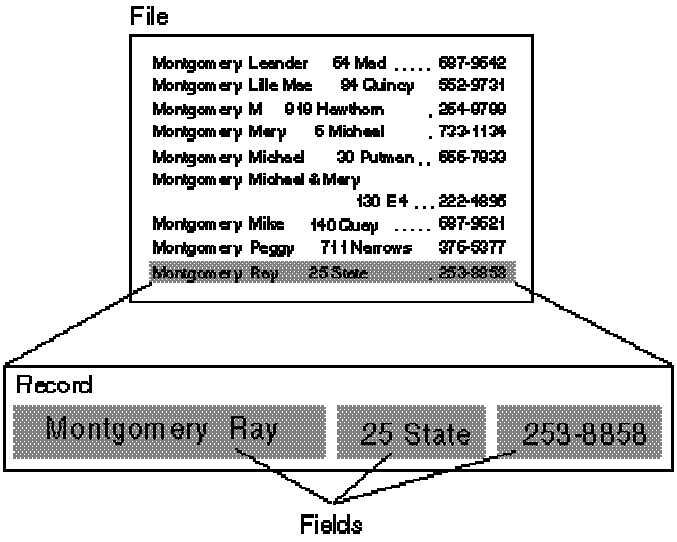


Figure 3-1 - Traditional database design[31]

[31] See (aol.pcwebopedia.com/TERM/D/DATABASE.html).

In 1970, E. F. Codd at IBM invented the term relational database with the objective to facilitate user requests to available data. The RDBMS stores data in the form of related tables (see Figure 3.3) and is a special type of database management system (DBMS) which is needed to access information from a database.[32]
However, the term 'relational' does not have its roots in the fact that tables are related to each other in a relational database. Instead, it more accurately is derived from the terminology that Codd used to define the relational model. According to Codd, a table was actually referred to as a relation (a related set of information). Today, database designers more commonly use the terms tables, columns and rows (or physically files, fields and records as shown in Figure 3.2) while Codd introduced the terms relations, attributes and tuples.
In the relational model tables are used to represent "things" in the real world. This can be real-world objects or events. An example of an object might be a customer, an inventory item, or an invoice while examples of events could be orders or telephone calls. As describe above, tables consist of rows and columns. According to the relational model, each row in a table has to be unique. This can be guaranteed by assigning a primary key - a column that contains unique values for a table which assures that a given row can be uniquely identified via programming (CustomerId and OrderId are primary keys in Figure 3.3.).
To reference a primary key in a table and therefore the entire unique row, a foreign key, which is also a column in a table, is used (CustomerId is the foreign key in the Order table in figure 3.3.). Foreign keys are defined to model relationships in the real world, which can be one-to-one, one-to-many or many-to-many.[33]

Table: tblCustomer

CustomerId	LastName	FirstName	Address	City	State	ZipCode	Phone#
1	Jones	Paul	1313 Mockingbird Lane	Seattle	WA	98117	2068886902
2	Nelson	Greg	45-39 173rd St	Redmond	WA	98119	2069809099
3	Madison	Ken	2345 16th NE	Kent	WA	98109	2067837890
4	Jones	Geoff	1313 Mockingbird Lane	Seattle	WA	98117	2068886902

Record: 1 of 4

[32] See (aol.pcwebopedia.com/TERM/R/RDBMS.html).
[33] See (www.microsoft.com/TechNet/Access/technote/ac101.asp).

Figure 3-2 - Table for customers with primary key CustomerId

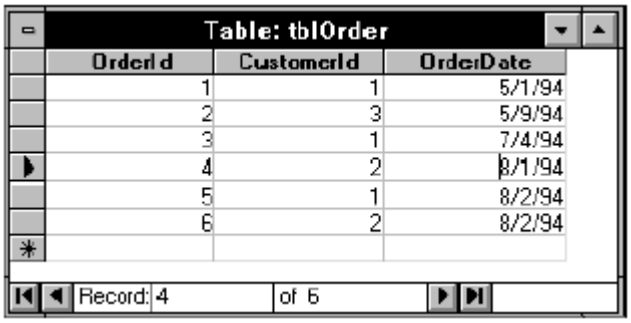


Figure 3-3 - Table for orders with foreign key CustomerId

Requests for information from a database are made in the form of a query.
SQL, which stands for Structured Query Language, is the standardized query language for relational databases. It is used to build queries that return information and gather data for reports. The sample SQL query in figure 3.5 requests ALL records in which the NAME field is SMITH and the AGE field is greater than 35.

```
SELECT ALL WHERE NAME = "SMITH" AND AGE > 35
```

Figure 3-4 - SQL Query Sample

Relational databases are most suitable for simple queries, e.g. the sales turnover of a particular sales region.[34]
The most important feature of relational databases is the obvious knowledge of how data is related and therefore how it can be extracted from the database. Due to this simplicity, a relational database can also be extended very easily and its size can be forecasted nearly precisely.[35]

3.3.5.2 Multidimensional DBMS and OLAP

The previous paragraph briefly describes the analysis of data stored in relational database management systems (RDBMS). Whereas relational databases facilitate the work with individual records, originally they were not designed for analyzing large amounts of data records.[36]

[34] See (Helmut Reinke et al, p. 45).
[35] See (aol.pcwebopedia.com/TERM/R/RDBMS.html).
[36] See (aol.pcwebopedia.com/TERM/M/MDBMS.html).

Multidimensional databases, however, are from the start designed for complex database queries. OLAP is one state-of-the-art technology, which is used to access and analyze multidimensional data. Although not a new concept, the term OLAP was originally coined by E. F. Codd in 1993. In general, OLAP allows viewing and analyzing of company data in an intuitive data model with a maximum of flexibility and performance.

3.3.5.3 The OLAP Data Model

The multidimensional data model stores and presents information in cubes, which are subsets of data organized and summarized into multidimensional structures.
More precisely, a cube is a large pool of data in which categorized information can be explored.
Each cube consists of dimensions and measures.
Measures provide the quantitative contents or numerical values.
Dimensions provide the categorized descriptions, which are needed to separate the above measures for further analysis.
The sum of all measures forms a special dimension called “Measures”. Example for measures would be sales turnover, sold units or work in progress, basically everything that can be measured and expressed in numbers.
A particular cube dimension in contrast to a measure can include a hierarchy of levels, which specifies the categorical breakdown of the dimension and will later be used for drill-down.
Figure 3.6 shows a possible hierarchy for the Sales Region dimension.

World

Continent

Region

Country

Figure 3-1 - Sales Region Dimension

The hierarchy goes from the most consolidated level, world, to the most precise level, country. Following the hierarchy from world to country, each level in the dimension is of a finer grain than its parent.
The OLAP data model is best visualized on paper starting with a simple two-dimensional table (Table 3.1).

	January	**February**	**March**
Europe	12	13	14
North America	22	21	17
Africa	10	15	18

Table 3-1 - Two-dimensional table

Each cell in the table above can be identified via its coordinates e.g. B2 where B stands for the column (“January”) and 2 represents the row (“Europe”). The value or measure of each individual cell is the cell content (“12”).
A graphical representation of table 3.1 can be seen in figure 3.7.

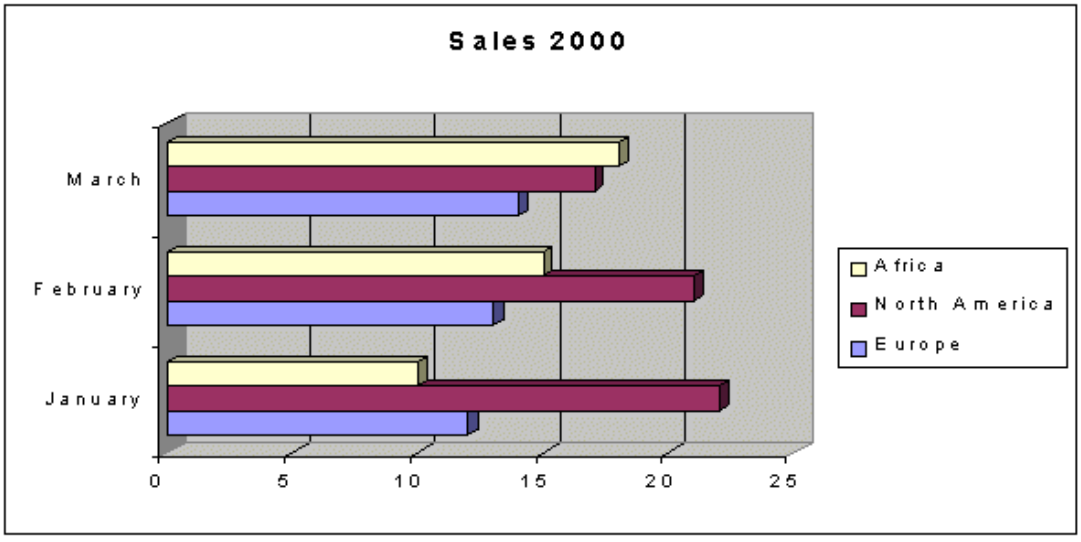


Figure 3-2 - Two-dimensional chart

The two dimensions in this simple sales table are the period or column dimension (X) and the sales region or row dimension (Y) which together form the two-dimensional coordination systems in figure 3.8.

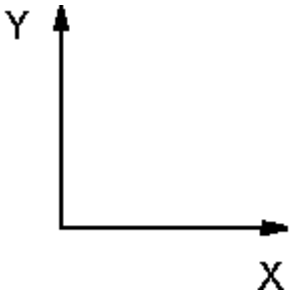


Figure 3-3 - Two dimensions

A third dimension added to the sales table could be the product group dimension (Figure 3.9) and would be dimension Z in the coordination system in figure 3.10.

	January	February	March
Europe	12	13	14
North America	22	21	17
Africa	10	15	18

Figure 3-4 - Set of tables

The third dimension cannot be adequately shown inside a particular sales table but is represented by an entire table in a whole set of tables. Each table displays the values of a particular product group.

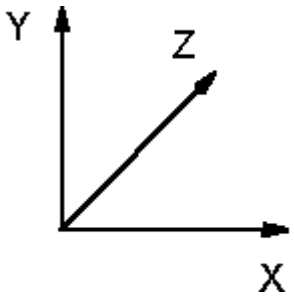


Figure 3-5 - Three dimensions

As described above, three dimensions can neither be shown in a table or in a chart even if it is possible to draw a three-dimensional coordination system on paper.

Therefore OLAP reports and analysis results always contain two-dimensional representations of existing data.
Consequently, multidimensionality – which means the presence of more than three dimensions – cannot be displayed at all. However, it can be described adequately with the following statement:
Each individual cell/point of data can be uniquely identified, by declaring the elements of each dimension. (Table 3.2)

Dimension / Measure	**Name**	**Element / Value**
Dimension	Product Group	Wine
Dimension	Sales Region	Europe
Dimension	Period	January
Measure	Sales Turnover	12

Table 3-2 - Dimension Elements

The end user navigates through the OLAP data by moving from one data level to another, which means that more consolidated or more detailed information is displayed. Apart from that, most OLAP applications allow for a simple and flexible arrangement of only the required information on the screen.

3.3.5.4 OLAP Architectures

In the early ages of the OLAP technology, database designers assumed that a non-relational database model would best fit into OLAP; therefore focus lied on multi-dimensional database structures.
The following paragraph will show that today relational and multidimensional databases can both be applied efficiently with regard to the special requirements and goals of a particular OLAP solution.

3.3.5.4.1 ROLAP

With the development of special database structures, e.g. the Star Scheme, which relates data tables in a particular way, and the use of data indexing and aggregation,

RDBMS were enabled for the use as OLAP data storage. This technology is consequently called relational OLAP (ROLAP).
Data in the central relational database is accessed via SQL queries. Multidimensional queries, therefore, need to be translated into a sequence of SQL statements.
Before multidimensional information is finally displayed on the screen, the extracted data is brought into a specific tabular format.
As queries containing complex SQL statements normally reduce the overall performance, summary tables are created in the source database that store already aggregated data and allow much faster access.
These summary tables represent the virtual cube in memory.
Altogether ROLAP has two main advantages:

- Large amounts of data are handled efficiently.
- The tabular representation of data can easily be extended; the number of potential dimensions is not restricted.

3.3.5.4.2 MOLAP

A data warehouse based on a MOLAP (multi-dimensional OLAP) architecture stores data in multidimensional databases structures. To achieve this, data needs to be transformed to a greater extend than in ROLAP applications. It is directly stored into cubes or data marts and can be accessed via SQL statements or via MQL, a special language for multi-dimensional queries.
The virtual cube that is created in memory therefore already exists in its multi-dimensional structures.
The main advantage of MOLAP architectures is the performance, which is achieved through the aggregation of data into cubes rather than into tables. However, this is also its main disadvantage since the volume of the OLAP data is far larger than in a comparable ROLAP solution.

3.3.5.4.3 HOLAP

Hybrid OLAP solutions are a combination of ROLAP and MOLAP architectures. They combine the advantages of both: high performance and high scalability. The center of the HOLAP architecture is a relational database that stores detail data, which is rarely needed. Data that is needed more often is stored in an aggregated

format in a multi-dimensional database. However, the main disadvantage of this approach is the administration effort needed for two different technologies.

3.3.6 Business Intelligence

The terms OLAP and Business Intelligence (BI) are often used synonymously although Business Intelligence is the more general concept that makes use of the OLAP technology.

A short but meaningful definition of Business Intelligence can be found on the IBM Business Intelligence Web Pages:

"Business Intelligence means using your data assets to make better business decisions. It is about access, analysis, and uncovering new opportunities." [37]

"In general, all processes, techniques and tools that support business managers in their decision making process belong to this area. Therefore, the main objective of BI is to supply every company member with the necessary information and to enable that person to make the right decisions in a permanently changing business environment." [38]

A typical Business Intelligence solution collects data from various data sources, which is then consolidated and aggregated. The data retrieval is easy and cost-efficient.[39]

Business Intelligence solutions integrate various functions and technologies like querying, reporting, OLAP, data mining and data warehousing. They follow the path of the MIS (management information system) of the 1970s and the DSS (decision support system) of the 1980s. BI is the 1990s follow-up technology and implies better integration and ease of use.

3.4 Groupware

As a consequence of the evolving client/server architecture in the late 1970s, more and more mainframe applications were replaced by solutions based on local area networks (LAN).

[37] See (Maria Sueli Almeida et al., 1999, p. 1).
[38] See (Stefan Ekrich et al., 1998, p.1).
[39] See (Stefan Ekrich et al., 1998, p.1).

Thus, users were enabled to share resources across their local networks, however, without the possibility to connect to external resources.
Soon after, applications were developed that allowed a direct collaboration of users and mainly consisted of file sharing and storage systems, multi-user databases and messaging solutions.
CSCW (computer supported collaborative work) as a new discipline in information technology was born, due to the need of more flexible support of collaboration and teamwork.
Software that was created to solve the problems of CSCW was called Groupware. At first, Groupware only combined the existing databases, messaging systems and LAN technologies to distribute and store the work of teams in local networks. However, companies identified the need for more flexible workgroups that would need to collaborate across regional areas.
In order to enable Groupware solutions for WAN (wide area networks), applications were developed to communicate between different operating systems and network protocols. This was achieved by shifting from a formerly platform specific to a now platform independent architecture.
Lotus Notes, regarded as the father of Groupware, was the first application that supported numerous network protocols and entirely abstracted from the underlying operating systems by introducing its own concept of a proprietary Notes structure across all network boundaries.
According to the relational database terminology, tables, records and fields are represented by views, documents and fields in a Groupware database. Each view row (document) is uniquely identified by a unique document ID, which is similar to the primary key in a relational table.

3.4.1 Definition of Groupware

A common definition of groupware cannot be found in the literature or on the Internet. However, all definitions mention teamwork and collaboration at the center of groupware. Solution built around this concept range from the simple use of email to applications that offer extensive collaborative functionality.
The following definition will be used throughout this work.

Groupware can be described as an application system that supports workgroups in their day-to-day business. There are three main functions that groupware solutions provide:

Communication:

Transfer and storage of messages is done electronically. Information is distributed and shared in electronic documents.

Collaboration:

A commonly used visual workspace is made available to all team members. All information is stored on the workspace.

Coordination:

Real world processes are simulated and executed in the visual workspace.

In order to fulfill these functions, groupware solutions have the following three main components:

- Databases that allow the organization and storage of data, messages, documents and methods.
- A distribution and access model that allows team members to get to the required information in a fast, secure and simple way.
- An integrated development environment to customize the entire system to the specific needs of different tasks.

Additional requirements for groupware solutions could be the availability on various operating systems and the possibility to integrate external information resources.[40]

3.5 Conclusion and valuation of technologies

Relational databases / OLAP and groupware as basic technologies both possess strong capabilities in their respective domains of application.

Groupware connects people and application systems and offers a platform for internal and external business processes. Therefore groupware systems represent a vital infrastructure for the specific functional areas of the Balanced Scorecard.

[40] See (Klaus Fochler et al., 1998, pp. 223).

An example would be the creation and distribution of tasks and actions for various team members or the direct and indirect communication between different organization units.

Groupware is much less suited for the specific needs of the Balanced Scorecard to calculate, aggregate, analyze or graphically represent “hard” numerical data. “Soft” strategic and organizational data, however, can be more easily handled.

Relational database, OLAP and data warehouse technologies are specifically designed to deal with “hard” business data. They allow precise and efficient data modeling and analysis. However, various problems occur at the isolated application of these technologies due to lacks in the area of documentation, communication and distribution of information.

Furthermore, the complex functionality of OLAP tools more likely positions them as systems for specialists and professionals.

The analysis and valuation above reveals that both technologies can be used to supply complementary functions for a Balanced Scorecard application.

Consequently, an integrated solution based on both systems would make use of major synergetic effects.

4. Architecture and concept (Solution and prototype)

As described in various places in this work a major trend towards accounting and information systems that incorporate financial and non-financial measures with the organization's strategy and vision can be already identified across organizations. The concept of the Balanced Scorecard has been mentioned as a theoretical framework that is widely accepted to support organizations to do so.
More than ever before, managers need to navigate their organization through stiff international competition and changing market conditions. Furthermore, internally, they need to be able to make the best of their existing resources.
People are the vital part of every organization. They need to be enabled to effectively deliver on the company's strategic goals, which, however, can only be achieved by securely distributing the right information to the right person.
As a consequence, new requirements for organizational and technological support become obvious. Various technological concepts to support organizations in the development, implementation and distribution of state-of-the-art applications have been described in the second chapter.
Database technologies like relational or multi-dimensional databases have facilitated storage, use and access of company data. OLAP as a further technology in this area, adds more value to existing data by allowing users to efficiently gather and prepare data from various data sources for the use in management reports and extensive analysis.
At the same time, groupware occurred as the application system that effectively supports collaborative work and communications in organizations across different network protocols and operating systems.
In order to satisfy the need for a complete support of the Balanced Scorecard concept, an integrated solution needs to incorporate a combination of these technologies.
The Action-driven Balanced Scorecard (ADBS) has been developed with the goal to meet these requirements.
ADBS is a combination of applications for the secure and shared creation, modification and distributing of an organizational Balanced Scorecard.

The main goal of the system is to support managers in dependably delivering on strategy and in managing performance across departments, locations, countries and time zones.
ADBS provides support for organizations to achieve and maintain high performance by implementing the best practice habits identified in the first chapter.
Furthermore, it gives easy access to the organizational Balanced Scorecard, trend analysis, explanations of deviations and it supports detailed follow up by means of action management. The action management part enables users to create and follow up actions related to their key performance indicators on a daily basis.
This allows others to share information about progress on a continuous basis.
A library component appends functionality to browse through the relevant non-numerical information (actions, analyses, definitions of CSFs and KPIs, etc.) in an easy and structured way.
The following paragraphs and illustrations describe the underlying information model, show the general system architecture, outline the individual structural elements and explain the overall concept and procedures of the ADBS system.

4.1 Information model and system architecture

To better understand and fit the ADBS system into the overall context of this work, which is Performance Management and Balanced Scorecard, the following paragraph focuses on two main areas; the introduction of the underlying information model and a detailed explanation of the system architecture.

4.1.1 Information model

Figure 4.1 shows a representation of the performance management process, which can be sub-divided into five major parts.

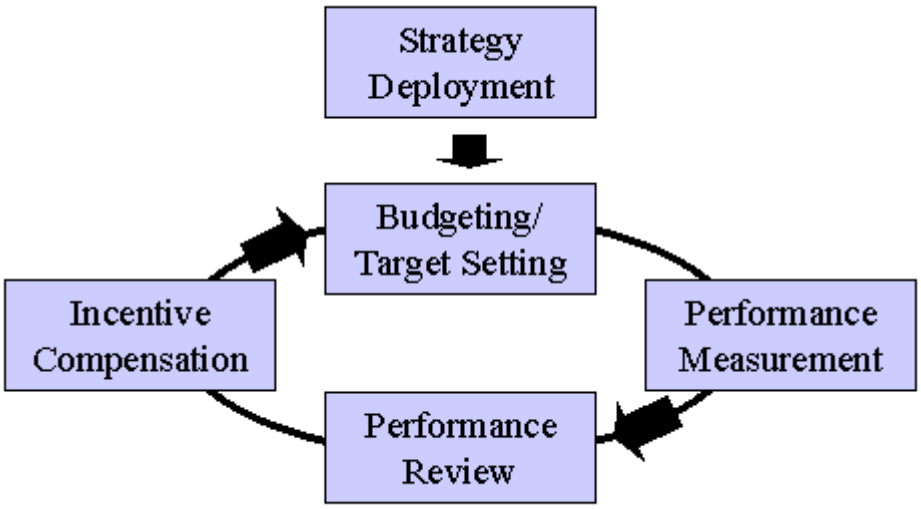


Figure 4-1 - Performance Management Process[41]

The main constantly repeated steps are (2) budgeting and target setting, (3) performance measurement, (4) performance review and (5) incentive compensation. They are preceded by (1) strategy deployment, which belongs to a less frequent cycle than the main performance management process.
On the level of senior management, strategic action plans are created, which include strategic goals and key value drivers that lead to significant competitive advantages.

[41] See (Morel Fourman et al., 2000, pp. 17-18).

Those will be translated into critical success factors as qualitative and key performance indicators as quantitative (and therefore measurable) information and will be made available throughout the entire organization.

At the operational level, managers put together action plans that focus on the continuous improvement of the key value drivers, on the efficient utilization of existing resources and on setting targets, comparative values and guidelines for historical, present and future periods.

In order to efficiently support step (2) and (3), data from various data sources needs to be collected, processed (including data consolidation and modeling, see value creation cycle in chapter 2), brought into the overall strategic context and distributed to the relevant people.

The most critical part of the performance management process is the continuously review of the actual, targeted and forecasted performance so that corrective, preventative and breakthrough actions can be initiated, assigned and thoroughly be taken to keep the organization on track.

The results of those actions can in the final step be closely linked to compensation initiatives, which make sure that people participate in the company's success.[42]

The performance review step feeds back into the budgeting and target setting step at the end of each cycle and this way closes the performance management process by starting a new cycle. Revised and newly created action plans and targets are put together and distributed again to the relevant people.

In general, performance management can be described as an iterative process of continuously repeated creation, measurement, review and execution of strategic action plans, which demands strong communications between all members of the organization.

The Balanced Scorecard will later be described as the general concept behind the structure of strategic action plans.

During the performance management process various kinds of information are constantly created, reviewed, modified and distributed.

These different types of information can be put into a general information model and allow a precise structural representation of the different sets of information objects.

[42] See (Morel Fourman et al., 2000, pp. 17-18).

4.1.1.1 Elements and structure

The information objects can be organized in groups. Each object in a particular group is related to one or more objects of the same or of another group. The sum of all groups determines the organizational Balanced Scorecard.

Object Group	**Objects**	**Meaning**
Organization and Security	Organization unit ADBS Group	Organization structure and groups for security
Strategy	Categorization	Objectives and critical success factors (CSF) (qualitative data)
Measures / Indicators	KPI Basic By Basic KPI General KPI (by org.)	Key performance indicators (KPI) and attributes (quantitative data)
Analysis and Actions	Analysis Action	Action and analysis for KPIs and Executive Summary
Reports	KPI Report	Graphical KPI reports
Traffic Lights	Traffic Lights	Target and comparison values
Data	Data Slice	KPI data in OLAP format (quantitative data)
Settings	Settings	Configuration and settings

Table 4-1 - Groups of Information Objects

The first group of information objects defines the organization structure and the security of the Balanced Scorecard.

The organization unit object is a representation of the real world organization unit and contains the key organizational attributes like members, managers, mission and strategy. Organization units are hierarchically organized.

ADBS Group objects are closely linked to organization units and determine their security. The information stored in the ADBS Group objects is used in all information objects throughout the entire application.

There are three default types of ADBS Group objects that determine access rights for the members of an organization unit: Readers, Editors and Organizational Administrators (Org Admins).

The type Readers object defines the members of an organization unit who can read documents belonging to that organization unit but cannot make any changes to nor delete any of them.

The type Editors object defines the members who can read documents belonging to this organization unit and can edit data documents. This means that unlike Readers they may also be able to enter data and be able to create and edit actions and analyses.

The type Organizational Admin object defines those members who are administrators of an organization unit. The Org Admin can create and edit the documents containing security and structural information for that organization unit.

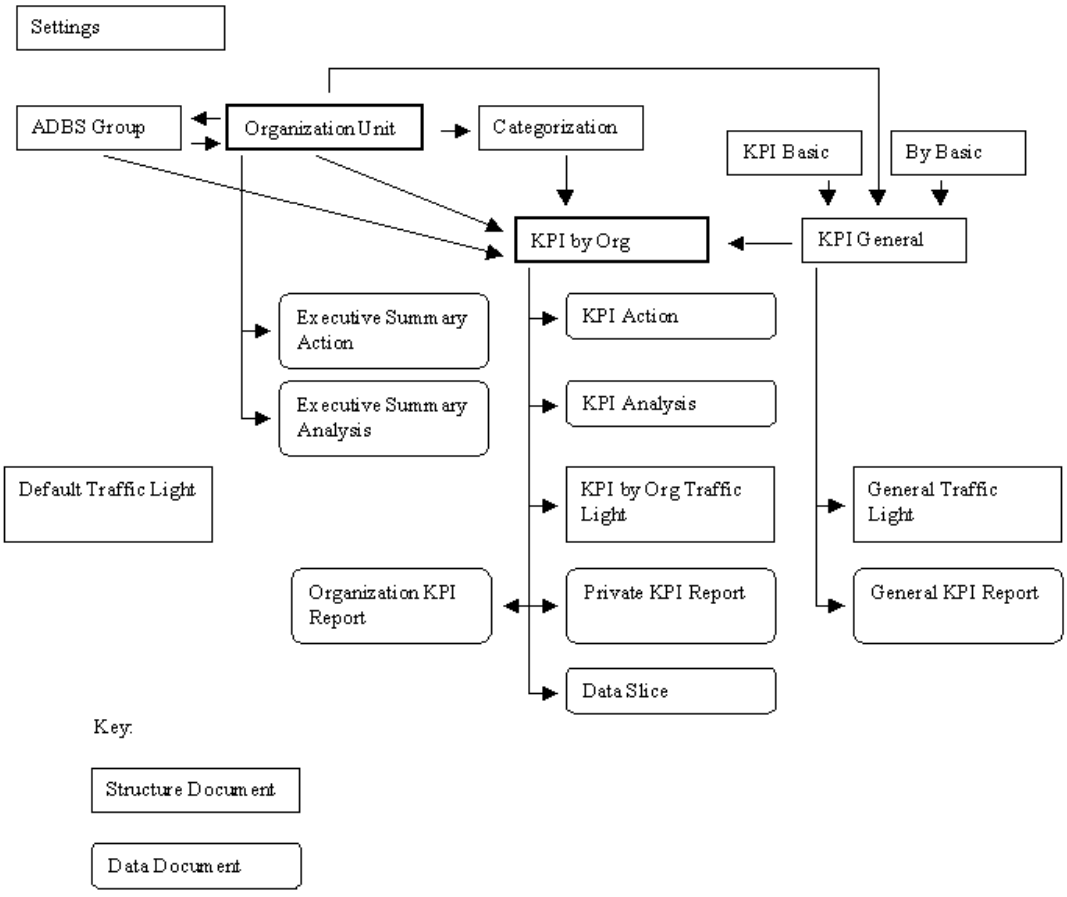


Figure 4-1 - Information Model

The next group of information objects represents the strategy of an organization. The categorization object includes the objectives (strategic goals) and critical success factors of an organization, which have been identified to maintain and support a competitive advantage in the organization's industry.

The measures or key performance indicators (KPIs) of the Balanced Scorecard provide the most important object group of the information model.

The main object in this group is the KPI by organization unit (KPI by org.) which receives information from ADBS Group, Organization unit, Categorization and KPI General information objects. It is at the center of the Balanced Scorecard and does not only receive information from but also transmits it to other information objects. These receiving objects are actions, analysis, traffic lights, KPI reports and data slices.

The KPI Basic and By Basic objects together form the KPI General object (See Figure 4.4).

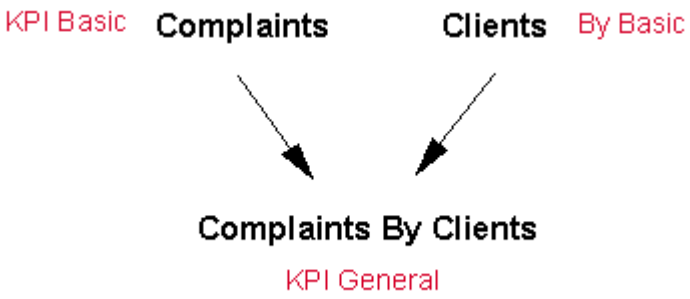


Figure 4-2 - KPI General Definition

The KPI Basic and By Basic objects contain a definition of the object instance as well as a list of delivery steps, which defines what kind of data needs to be collected, processed and distributed for this particular indicator. Additionally, the By Basic object contains a type definition which by default could be category, listing, ratio or top ten and the relevant type values.
The resulting KPI General objects are the basis for all key performance indicators across the entire organization. Apart from a detailed definition, they already contain the Balanced Scorecard perspective, which is later inherited into the KPI by org. information objects.
Similar to the KPI Basic and By Basic objects, KPI General objects have a list of delivery steps and additionally inherit the delivery steps from their source objects.

The main object of the third object group, the KPI by org. object, is defined for a specific organization unit and inherits information from one particular KPI General object. This does not necessarily need to belong to the same organization unit. KPI General information objects are made available for the entire organization and e.g. can be defined on the top organizational level and used throughout the hierarchical levels below.
The KPI by org. object inherits the mission and strategy of the parent organization unit object, the KPI definition of the KPI General object and the Objective and CSF of the Categorization object.
In contrast to KPI General objects, KPI by org. objects are directly used in the Balanced Scorecard as well as shown in the ADBS Application and therefore

additionally contain information about source data, reporting, strategy and display. The information can be categorized into the following groups:

Group	**Information**	**Meaning**
KPI Information (Data)	Meaning/Reason KPI Owner Periodicities Modes Data Entry	KPI information OLAP data information Data entry procedure
Reporting periods (Reporting)	Frequency Periods Start and End Date	Information on periods used in reports
Positioning (Strategy)	CSF and CSF Order Objective Perspective KPI Order	Strategy Information BSC Information
Used in (Display)	BSC KVD Trend KVD Org KPI Monitor	Choice of displaying the KPI in four different screens in the ADBS Application

Table 4-2 - KPI by org. Information

Traffic Lights objects store information about the background color of KPI by org. data that is shown in one or more screens of the ADBS Application and information about the symbols to be shown instead of the data.
There are three types of Traffic Lights objects: Default, General and KPI by org. Traffic Lights.
Default Traffic Lights objects are independent of a KPI and organization unit object and are therefore valid throughout the entire organization. General Traffic Lights objects are independent of the organization unit object, but belong to a specific KPI General object.

Finally, KPI by org. Traffic Lights objects depend on a particular organization unit and KPI by org. object. KPI by org. Traffic Lights override General Traffic Lights and General Traffic Lights override Default Traffic Lights.
Each Traffic Lights object represents a condition to be evaluated on the KPI by org. data to determine if a color and symbol are to be shown. This will be explained in more detail in the following chapter.

The Data object group is closely linked to the Measures/Indicators object group. It contains the Data Slice object, which stores the relevant data for each KPI by org. object in a special OLAP format. While KPI by org. objects store structural information, real data from the organizational business processes is stored in Data Slice objects.

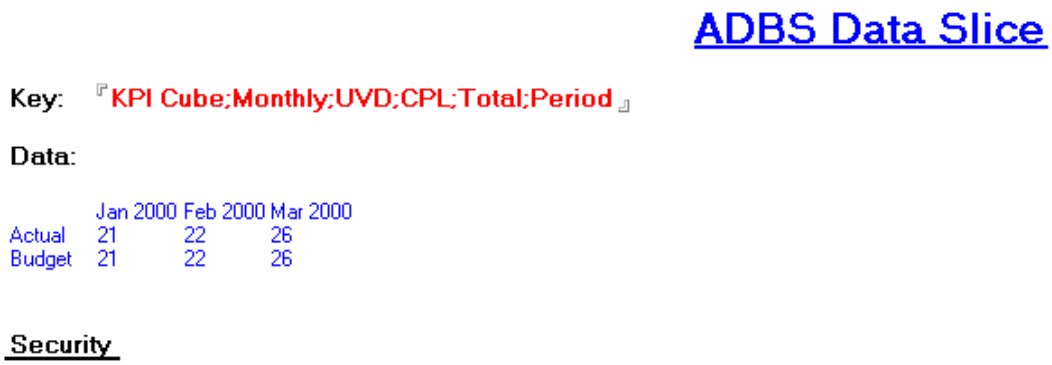


Figure 4-3 - Data Slice Object

As illustrated in figure 4.4 Data Slice objects consist of two parts: Key and Data information.
The Key information consists of the OLAP cube name to which the data slice belongs, the frequency of the KPI by org. data, the relation to the organization unit object, the relation to the KPI by org. object, a summary constant and the periodicity of the KPI by org. data.
The Data information is the real data behind the related KPI by org. object and is stored in the form of a table, in which the columns represent the periods and the rows represent the modes of the KPI by org. object.

The Report object group only contains KPI Report objects, which are used to store the graphical appearance of a particular KPI by org. object in the KPI Graphical

screen of the ADBS Application. KPI Reports can also point to data other than the KPI by org. data used in the ADBS system.

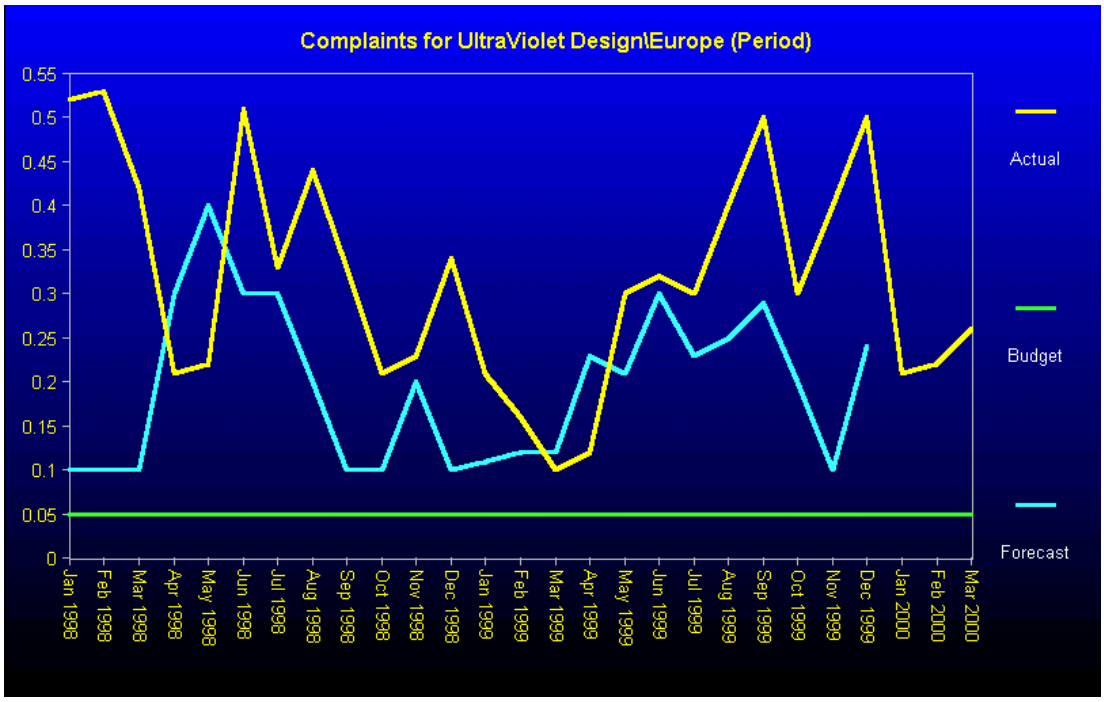


Figure 4-4 - KPI Report

There are 3 types of KPI Reports: General KPI Reports, Organization KPI Reports and Private KPI Reports. General KPI Reports depend on a particular KPI object but are independent of an organization unit object. Organization KPI Reports depend on a specific KPI by org. object and also on an organization unit object.
Private KPI Reports are quite similar to Organization KPI Reports, they also depend on a KPI by org. object and an organization unit object, but additionally belong to a particular user.

The objects in the analysis and actions object group contain information for the action management part of the described Balanced Scorecard system, which initially did not belong to the Balanced Scorecard concept as introduced by Kaplan and Norton.
Analysis and Action objects can be divided into two groups, KPI Analysis and KPI Actions, which directly relate to a particular KPI by org. and an organization unit object, and Executive Summary Analysis and Executive Summary Actions, which only belong to a particular organization unit object.

Analysis objects contain an explanation of the related KPI by org. or organization unit object for a specific period and are used to prepare Action objects for the same KPI by org. or organization unit.
Action objects are the result of KPI by org. measurement and profound analysis of the current situation which insights are included into the Action object.
There are three types of Action objects: Corrective Actions, which are used to correct measures of performance that are not on track, Preventative Actions, which deal with anticipated future problems and Breakthrough Actions, which serve to break through boundaries, assumptions and limits.
Information in the Action object mainly consists of overall Action information including a due date, an assigned person, a status, a detailed root cause gap analysis, and milestone management information including an assigned person, due date, status and planned value for each milestone.
The Analysis and Action Management Process will be explained in more detail in the next chapter.
The last group of information objects contains the Settings objects, which store overall configuration and settings information for the ADBS system. There are four types of Settings objects: Application Settings, General Settings, Software Settings and Personal Settings. They will be explained later in this chapter.

The above described information model categorizes the various information objects and determines the basic structure and relations inside the Balanced Scorecard system. The integrated structuring of information into a single model has many advantages.
It allows for an easy translation of complex strategic goals into simple measures (KPIs) with traffic lights functionality to quickly overlook and analyze what has happened in order to take the necessary action.

4.1.1.2 Semantic of the information model: the CSF/KPI library

Categorization, KPI Basic, By Basic, KPI General, KPI by Org. and Traffic Lights information objects are created and maintained in the CSF/KPI Library, which contains the strategic information of the Balanced Scorecard.

The CSF/KPI Library itself is contained by the ADBS Library, which holds all other related information objects: the configuration and settings, the organization structure, the ADBS Groups, the Data Slices and the KPI Reports.

In a broader sense, Actions and Analysis also belong to the ADBS Library although they do not initially determine the structure or appearance of the Balanced Scorecard.

The ADBS Library contains all information needed for the ADBS system, it also retrieves information from other systems and provides information for the ADBS Application described in the architecture model in the next section.

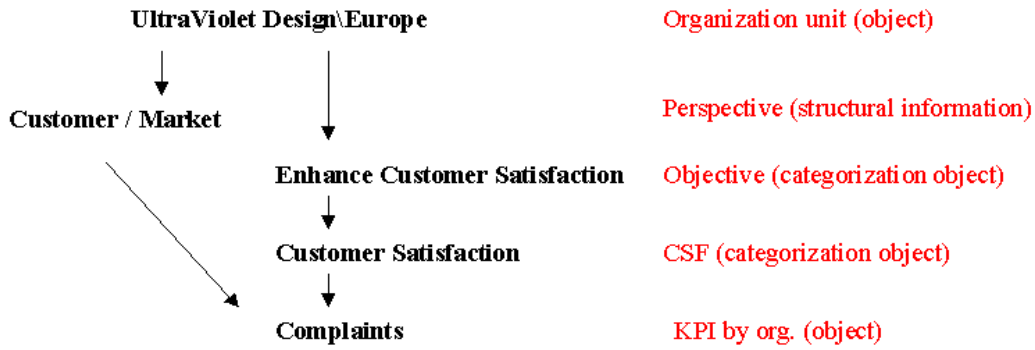


Figure 4-1 - Example structure in CSF/KPI Library

4.1.2 Architecture model

In terms of technology, the ADBS system is a combination of integrated application sub-modules and specialized tools based on a distributed Groupware platform that allows organization-wide communications and information management.

The entire system architecture is illustrated in figure 4.7.

The ADBS system can be divided into two layers of system components: the first layer includes the Frontend and the second layer the Backend modules.

Furthermore, the structural elements can be categorized into three parts depending on their functionality: ADBS System, OLAP Transformation and Data Integration.

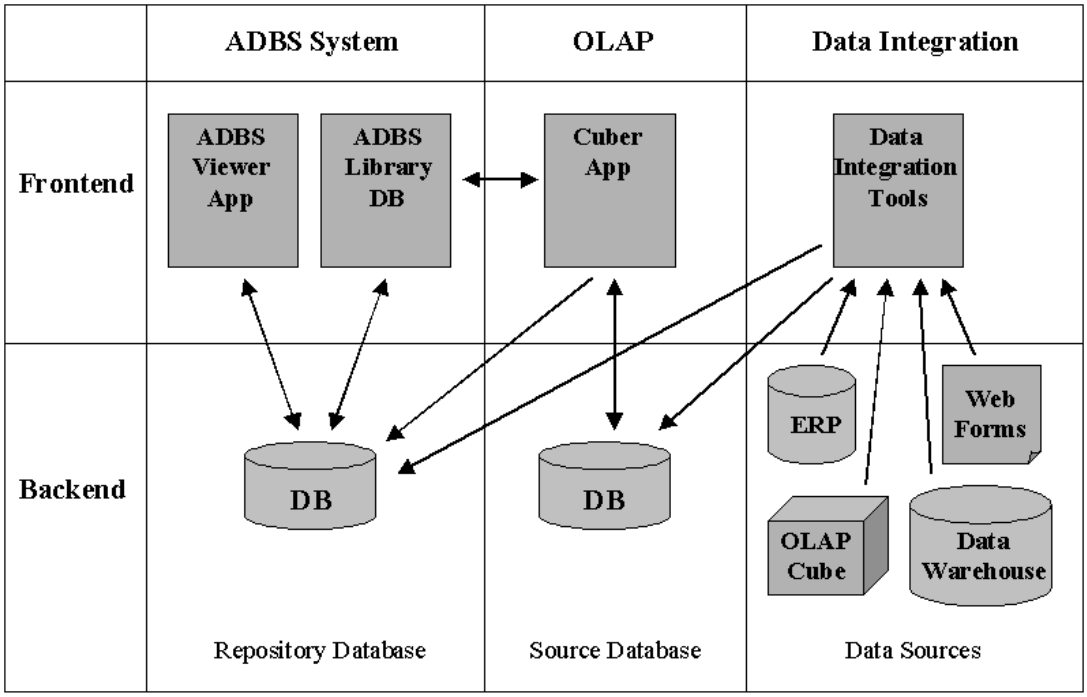


Figure 4-1 - ADBS Architecture Model

In the ADBS System part of the Backend layer a single repository database holds the entire information and data of the ADBS system. It is based on the Lotus Notes Groupware architecture and can be easily replicated and distributed throughout the entire organization.

All information objects described in the information model above are stored as document objects in the repository database. The use of the distributed system platform Lotus Notes guarantees all advantages of Groupware systems listed in the previous chapter. As underlying system infrastructure it allows sharing of information across various platforms and organizational boundaries.

The Frontend layer of the ADBS System contains the ADBS Viewer Application, referred to as ADBS Application, and the ADBS Library database. The ADBS Application is a graphical user interface, which displays the Balanced Scorecard and allows business users to interact with the system.

The ADBS Library database is used to create and maintain the necessary information and data for the ADBS system. The Cuber Application in the OLAP Transformation part of the Frontend layer is closely linked to the ADBS Library and is used to create and maintain the Data Slice objects in the repository database.

It directly retrieves data from Groupware databases as shown in the Backend layer. The extracted data is transformed into a special OLAP format and stored in the form of document objects in the main data repository.
While the components in the first two parts of the ADBS System are set, the Data Integration part contains various modules depending on the organizational environment.
The Backend layer can contain a vast range of different data sources as ERP (Enterprise Resource Planning) systems, Data Warehouses, existing OLAP Cubes, Web forms or simple Spreadsheets. Consequently, depending on the type of data source, the data integration tools in the Frontend layer can also vary.
The modular design of the Frontend components allows addressing of different sets of users and handling of various kinds of information. Users can be categorized by their access rights to the available information as described above or by their function, e.g. administrators or business users, while information can be classified by its format, purpose or source.
The core ADBS system consists in the Backend layer only of the repository database and in the Frontend layer of the ADBS Application, the ADBS Library database and the Cuber Application.

4.2 Structural elements and system design

This chapter describes the particular modules of the ADBS system with regard to the central system structure, properties, functionality and general concepts.

The core modules of the ADBS system and the modules of the previous Data Integration cycle are illustrated in figure 4.8.

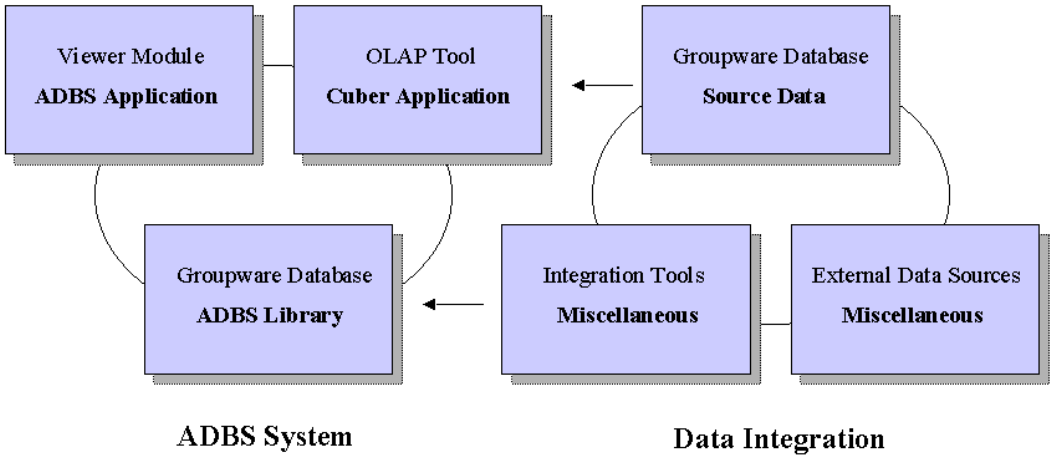


Figure 4-1 - Structural Elements

The following chapter concentrates on the ADBS system modules and only gives a general overview of the Data Integration modules.
The ADBS system consists of three main components. The first module is a specially designed Groupware database, the *ADBS Library*.
Further modules are the *ADBS Application*, a graphical user interface for the interaction with the ADBS Library database, and the *Cuber Application*, an OLAP tool for the extraction, transformation and storing of source data in the relevant OLAP format.

4.2.1 Functionality of the system modules in the overall process

To better understand the detailed explanations of the system components, this chapter begins with a general overview of the ordering and utilization of each module in the overall process.

Figure 4.9 illustrates the three system modules with their relations and the order in which they are used.

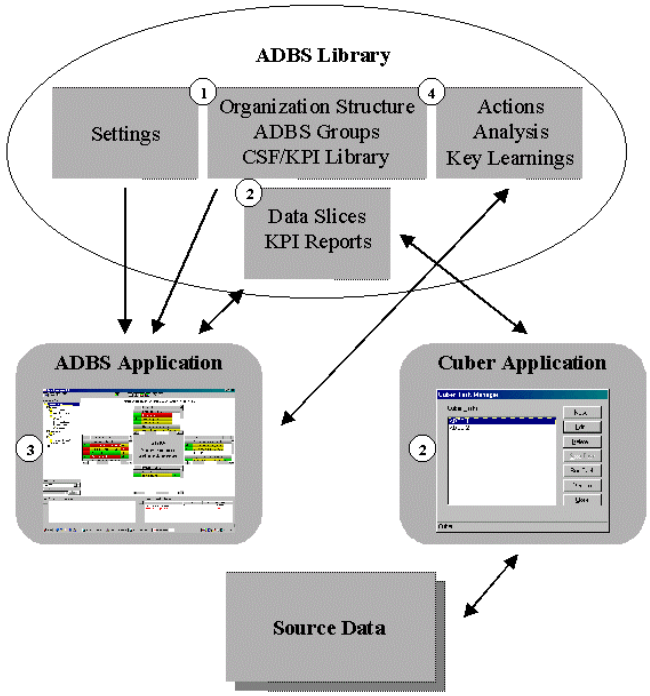


Figure 4-1 - Core Structural Elements

As described in the previous paragraph, all ADBS system information is stored in the ADBS Library database, which is also the starting point when establishing an organizational Balanced Scorecard.

The ADBS Library consists of Lotus Notes document objects containing security and structural information as well as Lotus Notes documents containing data. Security and structural information is created and maintained by people in administrative roles: the access rights of users, the structure of the organization, the pool of centrally defined CSFs and KPIs, those KPIs that are relevant for a certain part of the organization and the traffic light settings.

The highest level administrator in the ADBS system is the ADBS Administrator, referred to as the ADBS Admin. The ADBS Admin is able to define and edit the security and top-level structural information in the ADBS system.

The next level administrator is the Organizational Administrator, referred to as the Org Admin. The Org Admin belongs to a specific organization unit and controls the users who have access to that organization unit and to the pool of CSFs and KPIs available. Furthermore, the Org Admin creates the CSFs, KPIs and Traffic Lights that are relevant for that organization unit.

Before defining security and top-level structural information, the ADBS Admin needs to configure the ADBS Library database and the ADBS Application.
Three kinds of settings need to be provided: Software Settings, General Settings and Application Settings, which determine appearance, functionality and user as well as organization specific features of the system components.
The next step the ADBS Admin needs to take, is the creation of the organization structure and the ADBS Groups, which determine read, edit and administration access rights for users depending on a particular organization unit. It also includes the definition of the organizational administrators (Org Admins).
This way, the Org Admins are enabled to create structural information as document objects in CSF/KPI Library.
As a main result, all strategic information e.g. Objectives, CSFs, KPIs and Traffic Lights with their respective details are made available for sharing and distribution throughout the entire organization.
The organization structure and the CSF/KPI Library contain all necessary information to determine the complete structure of the Balanced Scorecard (BSC).
After having defined the BSC structure, the respective Org Admin of each organization unit needs to collect, transform and deliver data for the BSC.
The Cuber Application is used to extract source data from pre-defined data sources and to transform it into the relevant OLAP format.
This is achieved by defining Cuber Tasks, which include the data source, the OLAP data destination, the measures and the cube structure including the definition of the OLAP dimensions.
The Cuber Application creates Data Slice documents in the ADBS Library, which contain the data content of the Balanced Scorecard.
After having prepared the ADBS system structure, security and data, the ADBS Application can be used to view and navigate through the Balanced Scorecard, to measure performance and to interact with the system.
The ADBS Application is at the center of the ADBS system and is the main module for business users while the above-described part of the ADBS Library and the Cuber Application are specific to administrative users.

The ADBS Application shows the organization structure, the time periods, the Balanced Scorecard in four different screens, the KPI Reports in a special KPI Graphical screen and the Actions and Analysis.
The KPI Graphical Screen contains a graphical representation of a selected KPI and can be used to create and maintain KPI Reports as well as to directly enter and modify KPI data via the integrated Data Entry Tool.
All relevant Actions and Analysis are shown for each KPI or for a particular organization unit when switching to the Executive Summary level and can be directly created and modified.
The last step of the overall process involves two further parts of the ADBS Library: the Knowledge Library and the Administration component.
The Knowledge Library is an additional Lotus Notes based interface for business users and displays the Actions and Analysis as well as the resulting Key Learnings in special Groupware views.
The Administration component is a supplement to the first part of the ADBS Library and allows maintenance of the KPIs, the organization structure and the ADBS Groups. Furthermore, Org Admins are enabled to modify and maintain security for KPIs and organization units.

4.2.2 Groupware Databases

The complete information of the ADBS system is stored in a single Lotus Notes Groupware database, the ADBS Library. Lotus Notes databases provide an ideal infrastructure for storage, retrieval and distribution of organization-critical information. The general information objects introduced in the section ‘Information Model’ at the beginning of this chapter are stored as document objects, referred to as documents. The user interface of the database presents documents with all relevant information and functions in so-called ‘forms’ depending on the user access rights.
A ‘view’ is another graphical user interface in Lotus Notes databases presenting documents. Views are used to structure and select documents via simple formulas and depending on the user access rights.

4.2.3 The ADBS Library – Balanced Scorecard Structure and Security

As described in the previous paragraph, two types of administrative users prepare the security, structural information and data for the ADBS system: the ADBS Admins and the Org Admins.

The Setup part of the ADBS Library database is used to provide the security and the structural information of the Balanced Scorecard. A special Setup navigator (see figure 4.10) is presented to the administrators, which lists all administrative areas in the order they need to be performed. A similar navigator with reduced functionality will be shown to normal business users.

A navigator is a graphical user interface in a Lotus Notes database that allows database designers to simplify and customize navigation in an application.

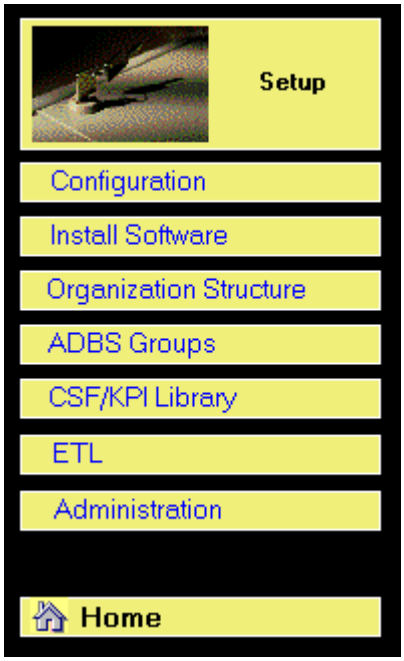


Figure 4-1 - Setup Navigator

The steps Configuration, Organization Structure and ADBS Groups are carried out by the ADBS Admin while the CSF/KPI Library lies in the responsibility of the Org Admins, which were previously defined in the ADBS Groups. All these steps belong to the first part of the overall process.

ETL (Extraction, Transformation and Loading) is closely linked to the Cuber Application and will be described in the next main section.

All created document objects in the sections Organization Structure, ADBS Groups and CSF/KPI Library are updated and maintained in the Administration section.

4.2.3.1 Configuration

There are three types of configuration documents that need to be created by the ADBS Admin: Software Settings, General Settings and Application Settings.

4.2.3.1.1 Software Settings

The Software Settings document contains information about the core and about additional modules of the ADBS system.
The ADBS Admin can define that a Data Entry database is used and where exactly it is located. The same can be done for an external organization database.
While a Data Entry database works as a data source for the Cuber Application, an external organization database can be used to deliver the organization structure for the Balanced Scorecard that would hence not need to be newly defined.
Furthermore, it can be set if the Cuber Application is used as a module in the ADBS system and which version of the ADBS Application is recently used.
Finally, the ADBS Admin defines if Org Admins should be allowed to access the ETL section.

4.2.3.1.2 General Settings

The General Settings document contains keywords used in the ADBS Library, general system settings, data configuration settings and overall security settings.
The first option in the general settings documents deals with the statuses used in the Action Management part of the Action documents. (See Figure 4.11.)

Number	Status (description)	Symbol	"NOT ON TRACK"	Used in Attention List	Used in Action Pane
0.	INITIAL	None	No	Yes	Yes
1.	ON TRACK	Green Tick ✔	No	Yes	Yes
2.	NOT ON TRACK	Time Bomb 💣	Yes	Yes	Yes
3.	CLOSED	Red Cross ✘	No	No	No
4.	CLOSED AND REVIEWED	Green Tick ✔	No	No	No
5.		None	No	No	No
6.		None	No	No	No
7.		None	No	No	No
X		None	No	No	No

Figure 4-1 - Action Status Settings

The ADBS Admin can define up to eight status values that can be set by the user in the Action documents as well as a symbol for each value that will be displayed in all views containing Action documents.
One of the Status values need to be set as the 'Not on Track' value, which is required for a special Action view, the Action Attention List that only displays Actions that have exceeded their due date.
The next status settings also refer to this list and determine which Actions should be automatically set to the 'Not on Track' value by the system when an Action becomes overdue.
The last status settings determine the appearance of only specific Actions in the ADBS Application depending on the Status value.
The next section in the General Settings document also contains information about Action documents: it can be used to determine the name of the Analysis section containing the root causes that lead to the definition of a particular Action.
The General Settings document also allows the definition of the functions that are available by default when defining ADBS Groups for each organization unit.
Three types of functions are always set: Readers, Editors and Organizational Admin.
The usage of cascading CSFs/KPIs is also set in the General Settings. Cascading in this context means that Org Admins are allowed to use KPI General documents from an organization unit other than the one they are responsible for as the basic for the creation of a KPI by org. document. This becomes important when an organization defines KPIs at the top level and would like all organization units below to use them.
While the above-described general settings determine the overall configuration of the ADBS Library, the sections 'Periods and Frequencies' as well as 'Data Types' are required to determine the KPI by org. data.
The available reporting periods in the Balanced Scorecard are set by default to monthly, quarterly and yearly frequencies with their respective values.

	Frequency Name	Periods
1 (Default):	Monthly	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
2:	Quarterly	Mar, Jun, Sep, Dec
3:	Yearly	Mar
4:		

	Month, Year
Default Time Period:	Apr 2001

Figure 4-2 - Periods and Frequencies

The section ‘Data Types’ allows the definition of the available modes and periodicities for KPI by org. data that is prepared via the Cuber Application.
Modes determine the type of data which is set to Actual (real value) by default and can optionally be extended to other organizational specific types, as Budget (allowed value), Target (aimed value) or Forecast (expected value).
Periodicities are different representation of the same data displayed in the ADBS Application. The default value is Period, which shows the periodic value for each KPI. Other periodicities can be Year to Date, which shows the total of the preceding periods and the current period for a particular business year or MAT (Moving Annual Totals) which shows the total of the 11 preceding months and the current period.

	Obligatory Default	Optional Choices
Available Modes:	Actual	Budget, Forecast
Available Periodicities:	Period	Year to Date

Figure 4-3 - Data Types

The last option in this settings document determines if the Organizational Administrators in the document security can changed once a document was created. The ADBS Security Model will be explained in more detail later in this chapter.

4.2.3.1.3 Application Settings

There is a special settings document for the ADBS Application, which determines the functionality and appearance of the graphical user interface: the Application Settings. The ADBS Application has five main screens, the BSC Screen, the BSC Trend Screen, the KPI Monitor Screen, the KVD Trend Screen and the KVD Org Screen, which most of settings in this document refer to.
In the first two sections, the ADBS Admin defines which perspectives to use in the Balanced Scorecard and where they should appear in the main BSC Screen.

1	**2** Financial	**3**
4 Customer / Market	ADBS Show Business Arthur Andersen	**5** Internal
6	**7** Innovation & Learning	**8**

Figure 4-1 - Perspectives in BSC Screen

The next section determines the ordering of the KPIs as well as the titles and the contents of the columns in the KPI Monitor Screen.

Column	Title	Data to Show
1	Actual	Mode Current Period Actual
2	History	Traffic Light History
3	Present	Traffic Light Present
4	Future	Traffic Light Future
5		
6		
7		
8		

Figure 4-2 - Columns in KPI Monitor Screen

While the column titles can be freely defined, the column data is restricted to mode and period, traffic lights and period or deviation and mode (period).
Furthermore, the ADBS Admin can define if CSFs should be shown at all in the BSC, BSC Trend and KPI Monitor Screens and which buttons should be shown to switch to the relevant screen.

Default Chart Status:	(•) Show Symbols ( ) Show Data
Modes and Traffic Lights shown (Trend screens only):	(•) Fixed by Traffic Lights ( ) Determined By User
Show Periodicities for each KPI (BSC Trend, KPI Monitor & KVD Trend):	( ) Yes (•) No

Figure 4-3 - Miscellaneous Application Settings

The last two sections of the Application Settings document deal with general settings for all screens. They allow ADBS Admins to determine if symbols should be shown instead of numbers, if users should be able to switch between different modes and if periodicities should be shown with each KPI.

4.2.3.2 Module maintenance and installation

The modules Cuber Application and ADBS Application are centrally maintained in the ADBS Library. The Setup Navigator direct links to the installation documents that contain the installation files, which can be manually updated by the ADBS Admin.

Every time the ADBS Application is called from the ADBS Library, an automatic install program checks if the newest version of the ADBS Application is already present and installs it if necessary.

4.2.3.3 Organization structure

The organization structure provides a major part of the structural information that determines the Balanced Scorecard and is inherited into all other information objects in the CSF/KPI Library and into the ADBS Groups.

The organization structure consists of a hierarchy of organization units, which are each represented by a Lotus Notes document containing all necessary information. A particular organization unit is uniquely identified by an organization id (Org ID) but referred to by the organization name throughout the ADBS system. The organization name and the id will be inherited into every related document of the ADBS Library.

Further alternative organization names can be defined for a single organization unit, which allow for the use of matrix organizations in the ADBS Application.

All organization-specific information such as mission, strategy, default report frequency, the manager and the members of the organization unit are stored in the organization unit document and are partly inherited into the KPI by org. documents. An organization unit document can also contain a list of other existing organization units that is used to allow Org Admins from these organization units to use the By Basic, KPI Basic and KPI General documents from that organization unit in which

the list was provided. This concept of Cascading CSF/KPI is described in the previous chapter.
It is also possible to integrate an already existing organization structure stored in a separate Lotus Notes database. This is useful when organizations already use Lotus Notes applications that demand the definition of organization units.
The integration of an existing organization structure is however not an integral subject of this work.

4.2.3.4 Security Model

Distributed applications, which provide information to heterogeneous groups of users in various geographic locations, have a particularly high demand on user access rights and security.
The security model of the ADBS system is entirely based on the strong security capabilities of Lotus Notes.
Security in Lotus Notes is based on user names and can be sub-divided into three categories: access rights, roles and encryption.
Encryption and roles are both optional when securing Lotus Notes data while access rights are a mandatory security option and assure security on different hierarchical levels: server, database directory, database, view, entire document, document section and particular field. Furthermore, roles and access rights can also be used to restrict users from various parts of a database such as functionality, access to specific design elements or views.
Access rights and roles on the database level are determined in the Access Control List (ACL) and can be assigned to particular persons, particular servers, person groups, server groups and mixed groups.
Roles are defined by specifying a role name and assigning it to a particular ACL entry. Access rights are more detailed and include a hierarchy of different access levels: manager, designer, editor, author, reader and depositor.
As Lotus Notes security is based on concrete user names, more abstract groups and roles, it is possible without greater efforts to adapt this model to the specific needs of the ADBS system, which it determined by a central organization structure.
Encryption is another strong security option and allows users to secure information on different levels using public key encryption and single key encryption.

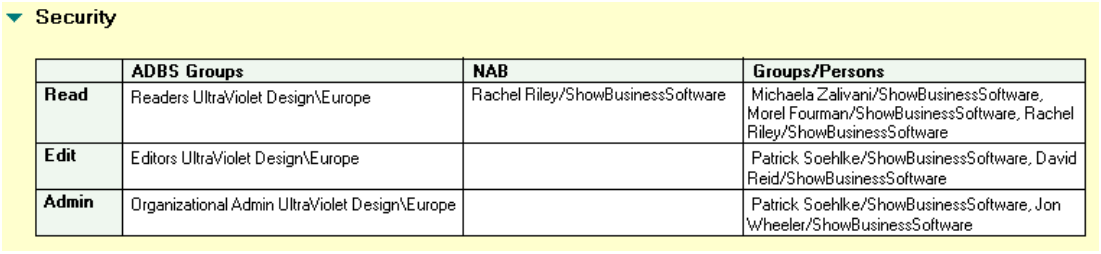
Two groups of users have already been introduced: ADBS Admins and Org Admins. ADBS Admin is a role in the ACL of the main repository database while Org Admins are defined through ADBS Groups.

4.2.3.4.1 ADBS Groups

The security of the ADBS system is almost completely determined through the ADBS Admin role defined in the database ACL and the ADBS Groups defined as Lotus Notes documents by the ADBS Admin.
Each ADBS Group document is directly related to a particular organization unit and inherits the organization name and the organization id. As described in the information model above an ADBS Group belongs to a particular type, which determines its function in the ADBS system. The three default types are mandatory: Organizational Admin, Editors and Readers.
The ADBS Group name is a combination of the function and the organization name while the ADBS Group ID is a combination of the function and the Org ID.
The Organizational Admin ADBS Group is inherited in almost every document of the ADBS Library and is automatically created when creating an organization unit document.
Members of an ADBS Group can be persons, existing groups or servers, which can be selected from a Lotus Notes Name and Address Book (NAB).

4.2.3.4.2 Document security

Each document in the ADBS Library contains a specific security section that stores all security information of the document. (See figure 4.17.)


Security

	ADBS Groups	NAB	Groups/Persons
Read	Readers UltraViolet Design\Europe	Rachel Riley/ShowBusinessSoftware	Michaela Zalivani/ShowBusinessSoftware, Morel Fourman/ShowBusinessSoftware, Rachel Riley/ShowBusinessSoftware
Edit	Editors UltraViolet Design\Europe		Patrick Soehlke/ShowBusinessSoftware, David Reid/ShowBusinessSoftware
Admin	Organizational Admin UltraViolet Design\Europe		Patrick Soehlke/ShowBusinessSoftware, Jon Wheeler/ShowBusinessSoftware

Figure 4-1 - Security Section

There are two special Lotus Notes fields that are used to ensure security on documents: Authors and Readers.
The Security section consists of three rows each representing the required document access rights: Read, Edit and Admin access. Each of the rows consists of three columns. The first column contains a list of ADBS Groups selected or inherited for the particular document that is closely connected to the third column, which holds the members of the respective ADBS Groups.
The middle column is an optional list of persons and groups that can be directly selected from the NAB without using the concept of ADBS Groups.
The Admin row of the security table is set by default to the Org Admin of the organization unit, which the document object is related to. This can only be changed when the respective option in the General Settings document is set. (See above.)

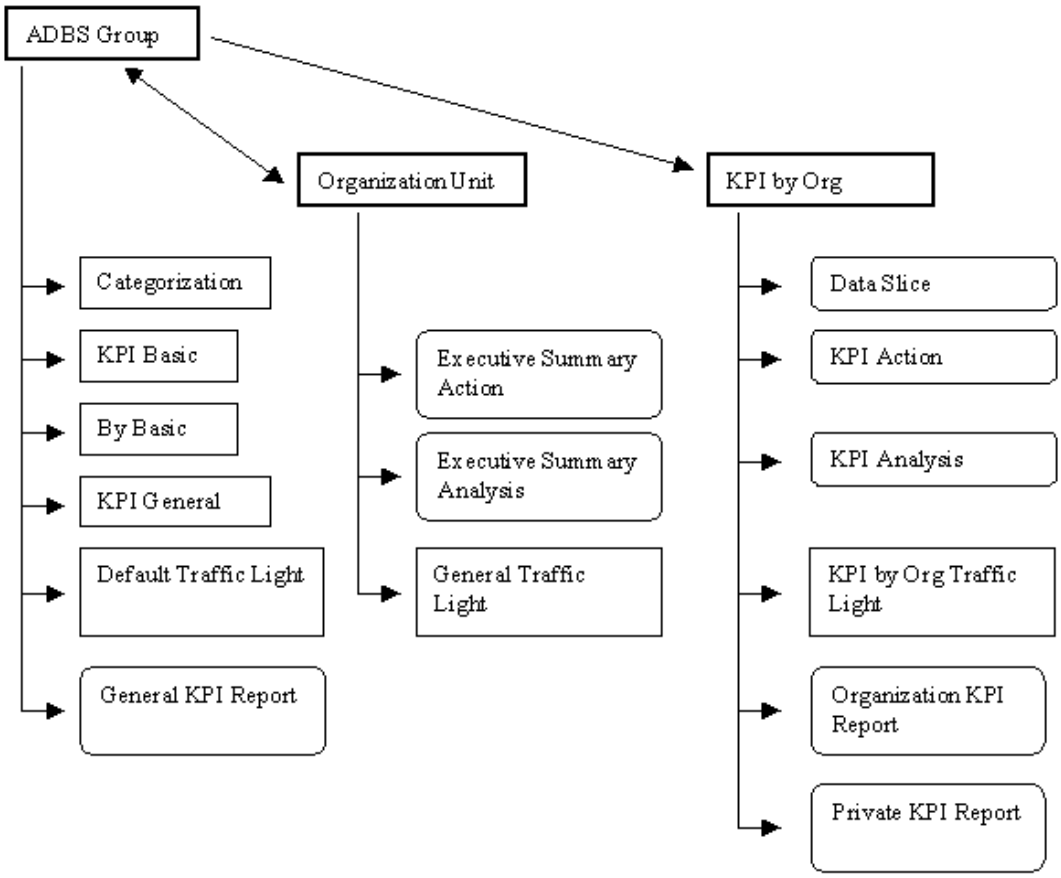


Figure 4-2 - Security Model

The complete security model is illustrated in figure 4.18. The main documents of the security process are the ADBS Group, the Organization units and the KPI by org. documents.
The organization unit provides organizational structure information for the related ADBS Groups and receives security information.
The Categorization, KPI Basic, By Basic, KPI General, Default Traffic Light and General KPI Report documents directly receive security information from the ADBS Groups.
The organization unit also receives security information from the ADBS Groups and passes it to three related documents: Executive Summary Action, Executive Summary Analysis and General Traffic Light.
The KPI by org. documents also pass the inherited security information to other documents: Data Slice, KPI Action, KPI Analysis, KPI by Org. Traffic Light, Organization KPI Report and Private KPI Report.
Maintenance and updates of security information is done in the Administration part of the ADBS Library described in the paragraph ‘ADBS Library – Administration’ and is only possible for ADBS Group, Organization unit and KPI by org. documents. All other documents receive information through the process described above.

4.2.3.5 CSF/KPI Library

The CSF/KPI Library has been already roughly described in the paragraph ‘Semantic of the information model: the CSF/KPI library’.
It contains all necessary strategic information as part of the Balanced Scorecard structure. A special navigator allows a fast and simple overview about all CSF/KPI Library documents, which are shown in views displaying a different information object each.

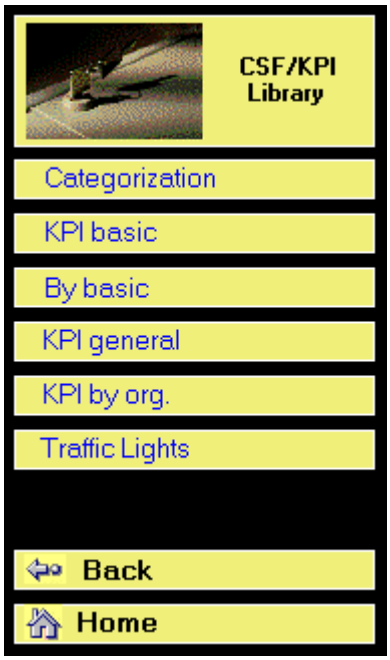


Figure 4-1 - CSF/KPI Library Navigator

All documents in the CSF/KPI Library are related to a particular organization unit and are created as well as maintained by Org Admins.

Categorization, KPI Basic, By Basic and KPI General documents contain structural information that is not directly shown in the Balanced Scorecard but lays the foundation for the creation of KPI by org. documents.

The main information in a categorization document is the combination of an objective (strategic goal) and a Critical Success Factor (CSF). Objectives and CSFs have a one-to-many relationship: a single objective can relate to several CSFs, while a particular CSF is always related to a particular objective.

The KPI Basic and By Basic information objects have been already described in detail in the information model above. They are used to create KPI General documents that provide the general measures for the entire organization.

When creating KPI General documents, an Org Admin already defines the KPI Name and the unique KPI ID, which are used throughout the entire system and are inherited into the related KPI by org. documents.

Although specific to a particular organization unit, KPI General documents can be used by Org Admins from other organization unit to create KPI by org. documents (See Cascading CSF/KPI).

KPI General documents already contain the Balanced Scorecard perspective, which will be inherited into the related KPI by org. documents.

4.2.3.5.1 KPI by organization unit

KPI by org. documents contain the quantitative information or the measures of the Balanced Scorecard and add a substantial part to the structural information provided by the Organization unit and the Categorization documents.
Apart from security, information in KPI by org. documents can be categorized into three areas: Organization information, KPI information and Reporting information.

Organization information			
Organization unit	UltraViolet Design	**Organization ID**	UVD
Mission	Become an industry leader in quality and customer satisfaction		
Strategy	Make the organization more efficient		

KPI information			
KPI	Returned products	**KPI ID**	RETP
Definition			
Meaning/Reason	Enhance customer satisfaction		
KPI Owner	Eric F. van Engen		
Relevant Periodicities	Period, Year to Date		
Default Periodicity	Period		
Relevant Modes	Actual, Budget, Forecast		
Data Entry	○ Manual ◉ Automatic		

Figure 4-1 - Organization and KPI Information

The KPI by org. document inherits the mission and the strategy of the related organization unit document as well as the organization name and the Org ID. Furthermore, as a KPI by org. document is always created from an existing KPI General document, it inherits the KPI name, the KPI ID, the KPI Definition, the BSC Perspective and the KPI Delivery Steps.
KPI information that is not inherited but newly defined is a KPI Meaning/Reason, the KPI Owner, the relevant Periodicities, the relevant Modes and the type of Data Entry, manual via the ADBS Application or automatic via the Cuber Application.
Data Entry for a particular KPI by org. lies in the responsibility of the KPI Owner and will be explained in the chapter ‘Cuber Application’ and ‘ADBS Application’.

Reporting information is divided into two sections: Reporting Periods and Positioning. The first section contains the KPI Frequency, e.g. monthly, the respective Periods, e.g. Jan, Feb, Mar, etc. and optional Start and End Date.

Positioning includes the Perspective, the KPI Order, the CSF, which is determined in the KPI by org. not in the KPI General and the CSF Order. This information is used to determine the position of the KPI in the Balanced Scorecard.
Apart from the structural information, the Org Admin or KPI Owner can determine in which screens of the ADBS Application the KPI by org. should appear.

Reporting periods			
Frequency	Monthly	**Periods**	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Start Date	Jan 1999	**End Date**	

Positioning		Used in	
CSF	Customer satisfaction	**BSC**	(•) Yes ( ) No
CSF Order		**KVD Trend**	( ) Yes (•) No
Objective	3. Enhance customer satisfaction	**KVD Org**	( ) Yes (•) No
Perspective	Customer / Market	**KPI Monitor**	(•) Yes ( ) No
KPI Order			

Figure 4-2 - Reporting Information

The general structure of the Security section has already been described in the Security Model. The KPI Editors of a KPI by org. document are specially enabled to manually enter data in the ADBS Application and create KPI Report, Traffic Lights, KPI Action as well as KPI Analysis documents for the respective KPI by org.
The Org Admins are only responsible for the general definition and the security of the KPI by org. document.

4.2.3.5.2 Traffic Lights

In the ADBS System Traffic Lights are used to easily overlook performance and to focus on those KPIs that are outside a certain range and need more attention. This kind of exception reporting shows those areas of the organization that managers need to act upon.
Traffic Lights documents store information that determines the background colors of the KPI data in the screens of the ADBS Application and the symbols to be shown instead of the data.
There are three types of Traffic Lights documents, Default, General and KPI by org. Traffic Lights, which are determined through the sections Organization information and KPI information.

Default Traffic Lights are not related to a particular KPI or Organization unit document and therefore do not contain Organization or KPI information.
General Traffic Lights do not contain Organization information, but relate to a specific KPI General document, while KPI by org. Traffic Lights contain both organization and KPI information and related to a particular KPI by org. document.
Security for Default Traffic Lights is only restricted in the Admin section to the ADBS Admin. General Traffic Light inherited security from the respective KPI General and KPI by org. Traffic Lights from the respective KPI by org. document.

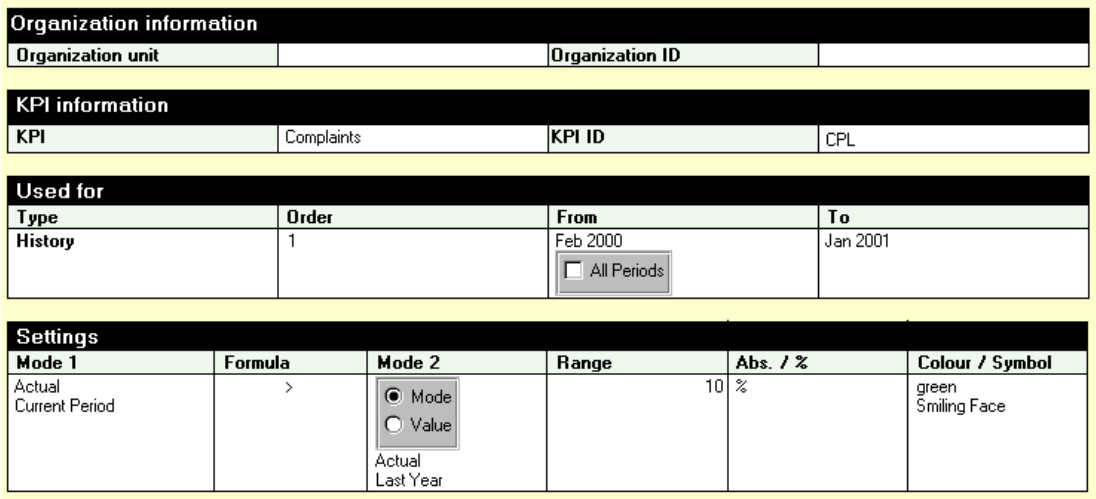


Figure 4-1 - Traffic Lights

Traffic Lights are further subdivided into History, Present and Future types. The BSC Trend, KVD Trend and KVD Org screens in the ADBS Application only use Present Traffic Lights. The BSC and KPI Monitor screens use all 3 types.
The Traffic Lights document can be restricted to a period of time and can be valid for all periods or can only be considered in a particular interval specified through a 'From' and 'To' date.
Each Traffic Lights object represents a condition to be evaluated on the KPI by org. data that determines if a color and symbol are to be shown.
The Traffic Lights condition is specified through a comparison between 2 values, Mode 1 and Mode 2, which are taken from the General Settings in case of Default and General Traffic Lights and from the KPI by org. in case of KPI by org. Traffic Lights documents.

Mode 1 always needs to be specified with the Mode of data, e.g. Actual, Budget or Forecast and the Time Period of the data relative to the Time Period being shown. Mode 2 can be specified the same way or can be substituted by specifying a comparison value.
Mode 1 and Mode 2 (or the specified value) are compared via formula, which can be: greater than (>), greater than or equal to (>=), equal to (=), less than or equal to (<=), less than (<), not equal to (<>) or Else.
The remaining part of the condition is the specification of the color and symbol to be compared when the condition is true.
The ADBS system will first attempt to find KPI by org. Traffic Lights documents for the KPI. If these exist, the settings are used to determine the traffic light color and symbol. If no KPI by org. traffic lights were found, the system attempts to find General Traffic Lights for the KPI.
If neither KPI by org. nor General Traffic Lights were found, the ADBS system searches for Default Traffic Lights. If no Traffic Lights were found, the KPI by org. data is not displayed at all.

4.2.3.6 ETL – Extraction, Transformation and Loading

In the Extraction, Transformation and Loading (ETL) section of the ADBS Library Setup, the ADBS system links to the organizational data sources and to the Cuber Application (Cuber). ETL is represented by a special Lotus Notes navigator and mainly consists of tasks that are related to Cuber.

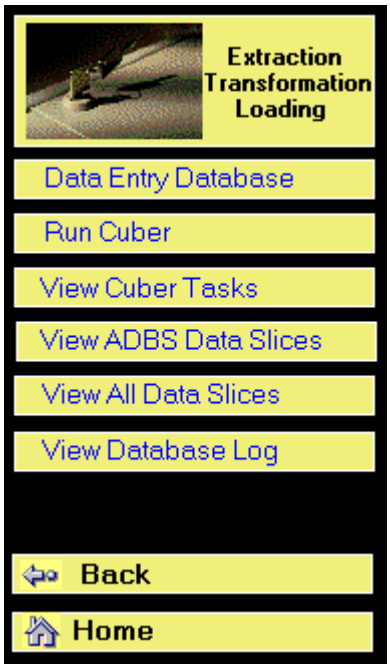


Figure 4-1 - ETL Navigator

The Data Entry Database, which contains the Cuber Source Data as a part of the Data Integration process described in the paragraph 'Structural Elements' can be directly accessed via the ETL Navigator as well as the Cuber Application itself.
The core components used in the Cuber Application can also be displayed in specific Lotus Notes views as well as the system log view, which contains information about system maintenance, updates and errors.
All parts that are specific to the Cuber Application are explained in detail in the following chapter.

4.2.3.7 ADBS Library Setup - Conclusion

The ADBS Library Setup prepares all necessary structural information for the ADBS Application in order to display the Balanced Scorecard.
The remaining part of the ADBS Library, the Administration, is used to maintain, update and control the information and security in the created documents and is described in the paragraph 'ADBS Library – Administration'.
Following the Setup, the Cuber Application is used to extract data from the pre-defined organizational data sources and transform it into the relevant OLAP format. This way, the KPI Editors also link KPI data to the respective KPI by org. and organization unit documents.

4.2.4 The Cuber Application – Balanced Scorecard Data

According to Kaplan and Norton, a Balanced Scorecard is used to provide an overview of the organization's overall performance by integrating financial and non-financial measures with key performance indicators around the four perspectives Financial, Customer/Market, Internal Processes, Learning and Growth.
As a result, Balanced Scorecard applications need to handle information from various data sources across the organization.
This information first needs to be located and extracted from the data source and transformed into the relevant application format. As a second step, it needs to be linked to the Balanced Scorecard organization structure and to the defined Key Performance Indicators (KPIs).

4.2.4.1 Data Integration

Data integration can be described as the process of harmonizing data from multiple data sources into a single representation. The main goal is to provide an integrated view over all relevant data sources and to provide a uniform interface to access all of the data. The data sources are normally independently designed for autonomous operation and often belong to different organizational entities.
The range of possible data source used in an organization can be large, e.g. databases, legacy systems or structured/unstructured files with different interfaces.
To extract data and to further integrate it into the destination system, a variety of data integration tools have been developed.
Lotus Notes provides by default strong data integration capabilities, which can also be used in the case of the ADBS system. The Lotus Domino Enterprise Connection Services (DECS) provides a common interface, which can be used to link to various data sources via so-called Connectors.
Data that has been extracted via a particular DECS Connector is stored in document objects in a Lotus Notes database.
There are various other data integration tools that can be used for the data integration process in the ADBS system, which are not subject of this work.

4.2.4.2 The Cuber Application (Cuber)

The Cuber Application demands source data to be located in a Lotus Notes Database.

The available data is directly read from a Lotus Notes view and needs to follow the following conventions: data needs to be complete and consistent and the view columns need to have titles.

4.2.4.2.1 Structure of the OLAP Cubes

The Cuber Application is directly started from the ETL navigator in the ADBS Library database and opens with the Cuber Task Manager.
Cuber Tasks are used to define a specific consolidation query of the data in the Source Database view.
Each Cuber Tasks needs to contain information about the location of the Data Source database and the view that contains the relevant KPI data.
The destination of the OLAP Cube is by default set to the ADBS Library database from which the Cuber Application was started.

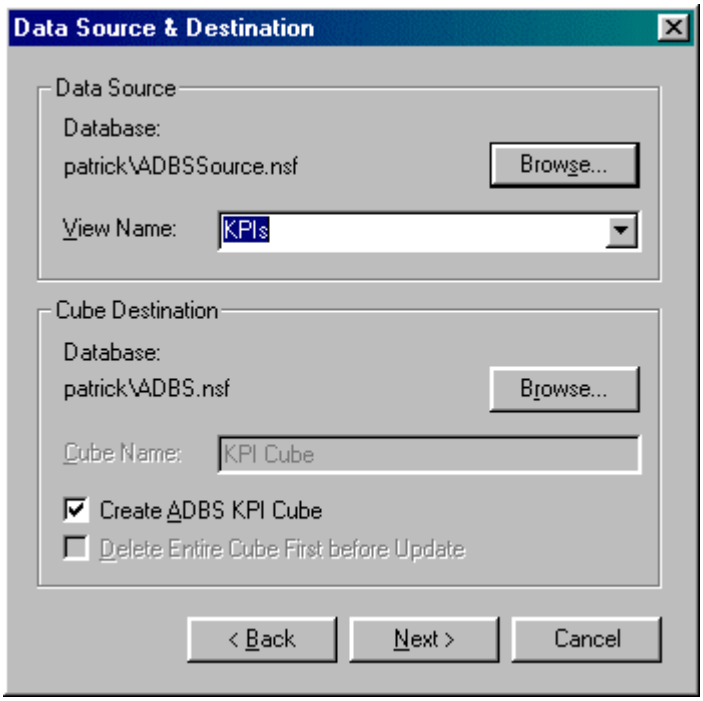


Figure 4-1 - Data Source

The Data Source View contains all necessary information to create Data Slice documents for a particular KPI by org. document.
Each line in the view represents a cell in the Balanced Scorecard and contains the Org ID, the Mode, the Frequency, a system specific summary constant (Total), the Periodicity, the KPI ID, the Period and the value.

Org Id	Mode	Frequency	Total	Periodicity	KPI Id	KPI	Period	Value
UVD	Actual	Monthly	Total	Period	CPL	Complaints	01/2000	21
UVD	Actual	Monthly	Total	Period	CPL	Complaints	02/2000	22
UVD	Actual	Monthly	Total	Period	CPL	Complaints	03/2000	26
UVD_EUR	Actual	Monthly	Total	Period	CPL	Complaints	01/2000	21
UVD_EUR	Actual	Monthly	Total	Period	CPL	Complaints	02/2000	22
UVD_EUR	Actual	Monthly	Total	Period	CPL	Complaints	03/2000	26
UVD	Budget	Monthly	Total	Period	CPL	Complaints	01/2000	21
UVD	Budget	Monthly	Total	Period	CPL	Complaints	02/2000	22
UVD	Budget	Monthly	Total	Period	CPL	Complaints	03/2000	26
UVD_EUR	Budget	Monthly	Total	Period	CPL	Complaints	01/2000	21
UVD_EUR	Budget	Monthly	Total	Period	CPL	Complaints	02/2000	22
UVD_EUR	Budget	Monthly	Total	Period	CPL	Complaints	03/2000	26

Figure 4-2 - Data Source View

The next step in the Cuber Task is to define the measures to be used in the OLAP Cube, which is in the case of the ADBS system simply the value shown in the Data Source view.

The final dialog of the Cuber Application is used to define the dimensions of the OLAP Cube. In this step, all remaining columns of the Data Source view are assigned to the different dimensions. Period becomes the X (Column) Dimension, Mode the Y (Row) Dimension and Frequency, Org ID, KPI ID, Total and Periodicity the Z-Pages or additional Dimensions.

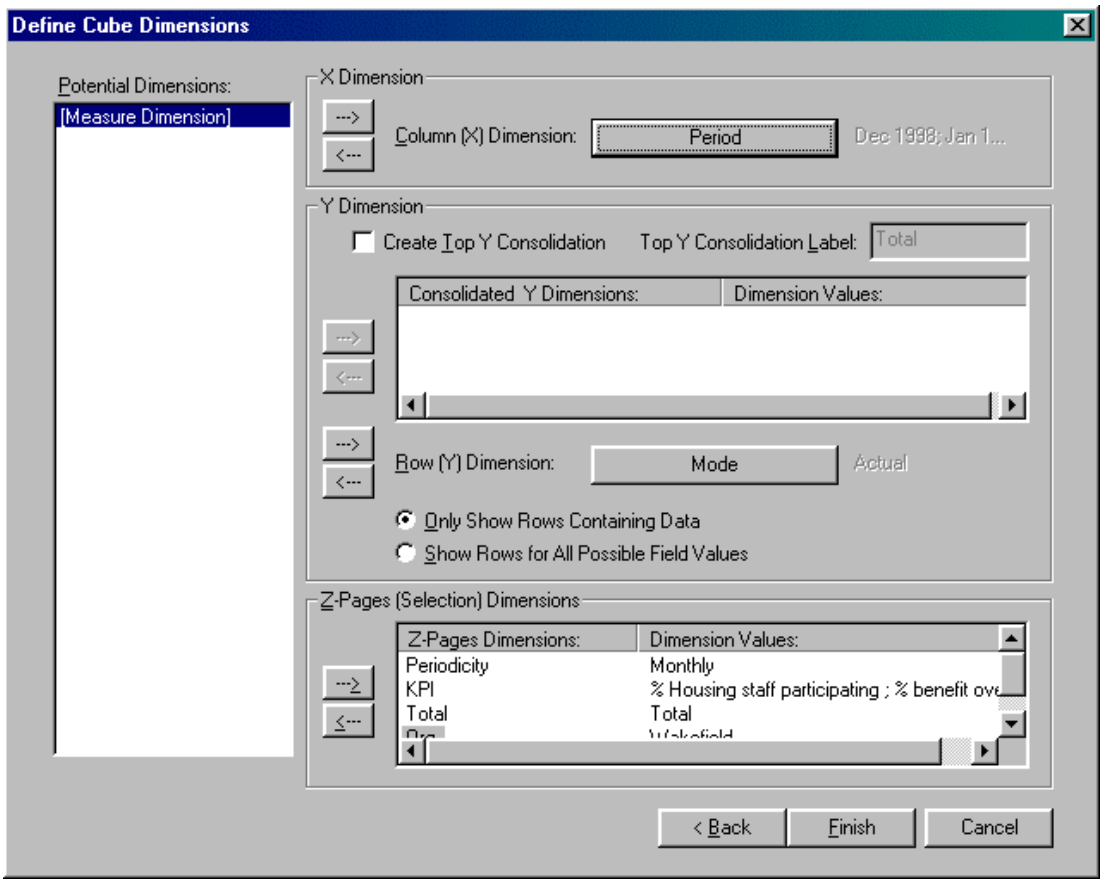


Figure 4-3 - OLAP Cube Dimensions

After having defined the Cube structure, the KPI Editors can manually run the Cuber Task or schedule it to run automatically on a Lotus Domino Server.

4.2.4.2.2 Data Slices – OLAP Cubes as document objects

The Cuber Application creates Data Slice documents in the ADBS Library database to store the contents of the OLAP Cube.

Each Data Slice document consists of a Key and a Data field as well as a Security section, which inherits information from the related KPI by org. document.

Key: KPI Cube Test;Monthly;UVD_EUR;CPL;Total;Period

Data:

	Jan 2000	Feb 2000	Mar 2000
Actual	21	22	26
Budget	21	22	26

Figure 4-1- Data Slices Document

The Key field contains the name of the OLAP Cube and the Z-Pages Dimensions while the Data field contains the Period, the Modes and the measures (values).
The Data Slice documents are the tabular representation of data for a particular KPI by org., which is shown in the screens of the ADBS Application.
The storage of OLAP Cubes in Lotus Notes documents allows the usage of all Groupware specific advantages described at the beginning of the third main chapter.
In combination with the structural information in the ADBS Library, the OLAP Cube provides all information to display the Balanced Scorecard in the ADBS Application.

4.2.5 The ADBS Application

The ADBS Application is a graphical user interface, which displays the Balanced Scorecard according to the security, structure and data provided in the ADBS Library. Users are enabled to directly interact with the system, to create KPI Reports, Action and Analysis documents and to use the Manual Data Entry Tool, which allows direct input of KPI data into the existing OLAP Cube.

4.2.5.1 Structural elements and components

The ADBS Application consists of seven main components: a Button bar, the Organization pane, the Time Period list box, the KPI Report list box, the main Screen pane, the Analysis pane and the Action pane. (See figure 4.28.)
The Organization pane is used to navigate through the organization structure created in the ADBS Library. Selections in the organization pane directly effect the Screen pane as well as the Analysis and Action panes. The currently selected organization unit is highlighted and the Balanced Scorecard as well as the Executive Summary Analysis and Actions of the respective organization unit are displayed.
Due to the security, users only see the information that they are entitled to see.
The Time Period list box allows the selection of a particular period and is only applicable for the BSC, KPI Monitor and KVD Org Screens.
There are five screens in total, which can be displayed in the main Screen pane apart from the KPI Graphical which is specific to a particular KPI by org.: BSC, BSC Trend, KPI Monitor, KVD Trend and KVD Org.

As described in the KPI by org. paragraph of the CSF/KPI Library section above, the Org Admins and the KPI Editors are authorized to determine in each KPI document in which of the screens it should occur. Furthermore, the start and end dates in the KPI by org. document are compared to the selected time period.

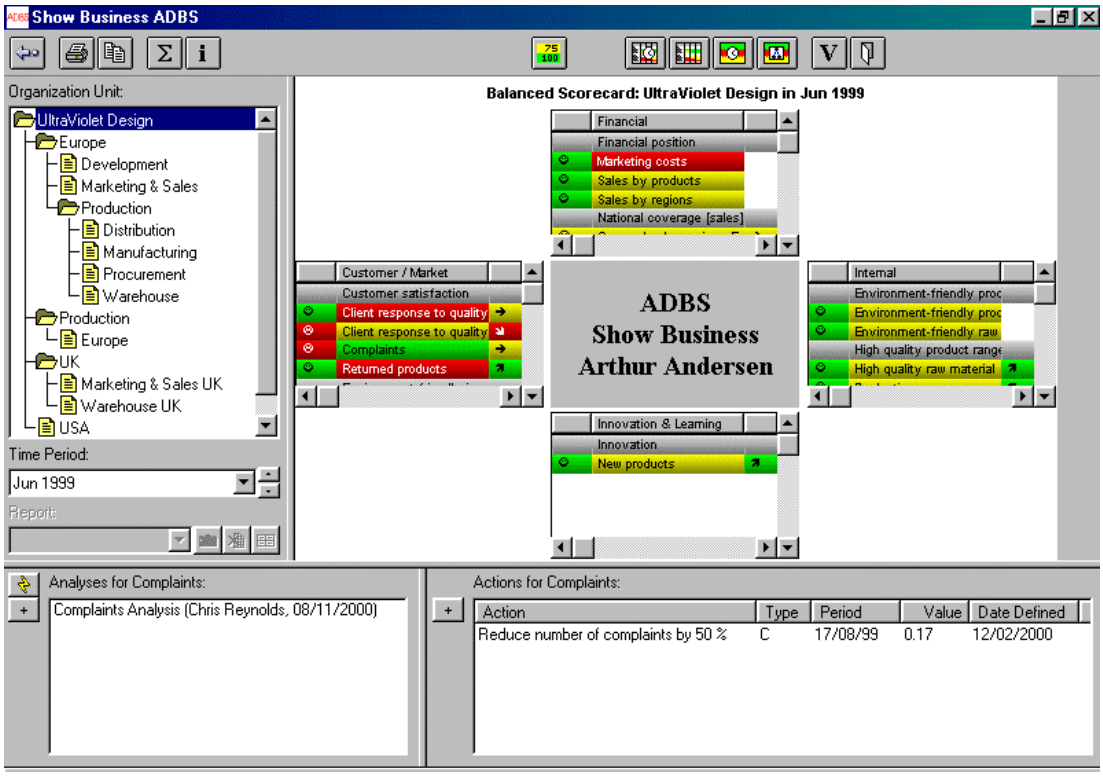


Figure 4-1 - ADBS Application

4.2.5.2 Screens

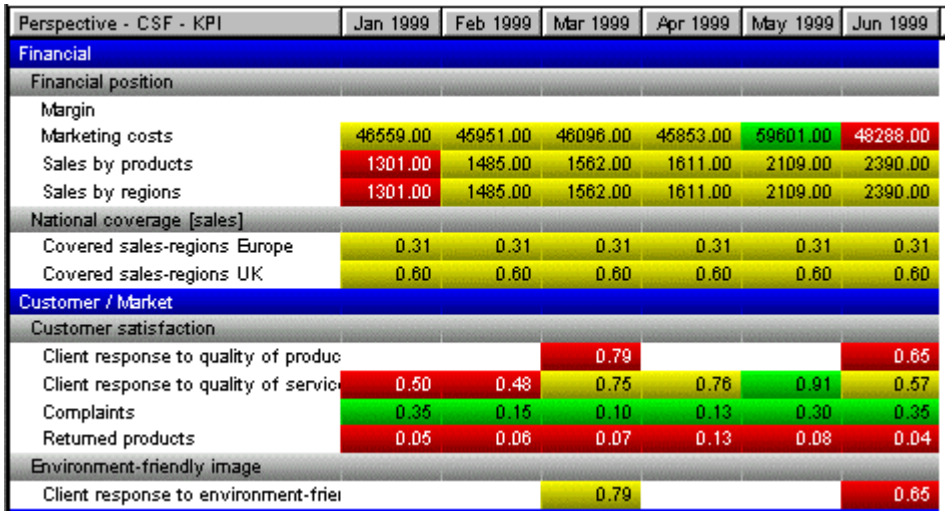
The BSC screen shows data for several KPIs of a particular Organization unit and a selected Time Period. (See figure 4.28.)

Each perspective of the Balanced Scorecard is shown in a separate chart, which contains the CSFs and the respective KPIs in hierarchical order.

The position of each chart on the BSC Screen and the text shown in the middle of the screen is determined in the Application Settings document in the ADBS Library.

The chart rows showing the KPIs consist of 3 columns, which represent History, Present and Future and are only filled with contents when the respective Traffic Lights have been defined in the CSF/KPI Library. The first column shows Mode 1 and the History Traffic Lights, the middle column the KPI Name and the Present Traffic Lights and the third column Mode 1 and the Future Traffic Lights.

The BSC Trend screen shows data for several KPIs of a particular Organization unit over a range of Time Periods. The information is shown in a single table chart and is sorted by Perspective or by Objective depending on the Application Settings, followed by the CSF and the KPIs. Each row showing a specific KPI is divided into columns, each for a particular time period and shows Mode 1 and the Present Traffic Lights.



Perspective - CSF - KPI	Jan 1999	Feb 1999	Mar 1999	Apr 1999	May 1999	Jun 1999
Financial						
Financial position						
Margin						
Marketing costs	46559.00	45951.00	46096.00	45853.00	59601.00	48288.00
Sales by products	1301.00	1485.00	1562.00	1611.00	2109.00	2390.00
Sales by regions	1301.00	1485.00	1562.00	1611.00	2109.00	2390.00
National coverage [sales]						
Covered sales-regions Europe	0.31	0.31	0.31	0.31	0.31	0.31
Covered sales-regions UK	0.60	0.60	0.60	0.60	0.60	0.60
Customer / Market						
Customer satisfaction						
Client response to quality of produc			0.79			0.65
Client response to quality of servic	0.50	0.48	0.75	0.76	0.91	0.57
Complaints	0.35	0.15	0.10	0.13	0.30	0.35
Returned products	0.05	0.06	0.07	0.13	0.08	0.04
Environment-friendly image						
Client response to environment-frie			0.79			0.65

Figure 4-1 - BSC Trend

The KPI Monitor Screen is similar to the BSC Trend Screen and does not show KPI data over a range of Time Periods but for a selected period. The KPI rows are divided into configurable columns displaying information specified in the Application Settings, e.g. the value of Mode 1 in the selected Time Period (Actual), the value of Mode 2 and Present Traffic Lights, Deviation of Mode 1 (Actual), etc. A complete list of possible settings can be found in the Appendix of this work.

Objective - CSF - KPI	Actual	History	Present	Future
1. Establish an environment-friendly image				
Environment-friendly product range				
Environment-friendly products	0.80	0.50	0.80	0.77
Environment-friendly raw material	0.80	0.50	0.80	0.77
Environmental-friendly packaging materi:	0.80	0.70	1.00	0.77
Environment-friendly image				
Client response to environment-friendly i				
2. Create international coverage				
National coverage [marketing]				
Covered Marketing-regions Europe	0.31	0.31	0.31	0.30
Covered Marketing-regions UK	0.60	0.60	0.60	0.60
National coverage [sales]				
Covered sales-regions Europe	0.31	0.31	0.31	0.30
Covered sales-regions UK	0.60	0.60	0.60	0.60
3. Enhance customer satisfaction				
Customer satisfaction				
Client response to quality of products				
Client response to quality of services	0.76	0.83	0.76	0.70
Complaints	0.13	0.30	0.00	0.30
Returned products	0.13	0.04	0.02	0.07

Figure 4-2 - KPI Monitor

The two remaining screens, the KVD Trend and the KVD Org Screen, are designed to allow business users to focus on a selected range of KPIs that need more attention than to display all. Each cell holds data for Mode 1 and shows the Present Traffic Lights.

The KVD Trend is similar to the BSC Trend Screen but does not show Perspectives, Objectives and CSFs.

	Jan 1999	Feb 1999	Mar 1999	Apr 1999	May 1999	Jun 1999
Margin						
Marketing costs	46559.00	45951.00	46096.00	45853.00	59601.00	48288.00
Sales by products	1301.00	1485.00	1562.00	1611.00	2109.00	2390.00
Sales by regions	1301.00	1485.00	1562.00	1611.00	2109.00	2390.00
Complaints	0.35	0.15	0.10	0.13	0.30	0.35

Figure 4-3 - KVD Trend

The KPI rows in the KVD Org Screen are divided into columns that each represent a particular organization unit with the first column holding the select organization unit and the following the hierarchy level below. This is particularly helpful when comparing KPIs across organization units.

	UltraViolet Design	Europe	UK
Margin		510000.00	167064.00
Marketing costs	48288.00	36146.00	12142.00
Sales by products	2390.00	1684.00	706.00
Sales by regions	2390.00	1684.00	706.00

Figure 4-4 - KVD Org

The Button Bar enables users to switch between the available screens, the display of data or symbols, the display of the Executive Summary level and the Scorecard Settings, which allow the selection of an alternative mode, frequency or range of periods to be shown in the screens.

4.2.5.2.1 KPI Graphical Screen

Each KPI in the Balanced Scorecard can also be viewed in the KPI Graphical Screen, which displays a graphical representation of the OLAP data behind a particular KPI.

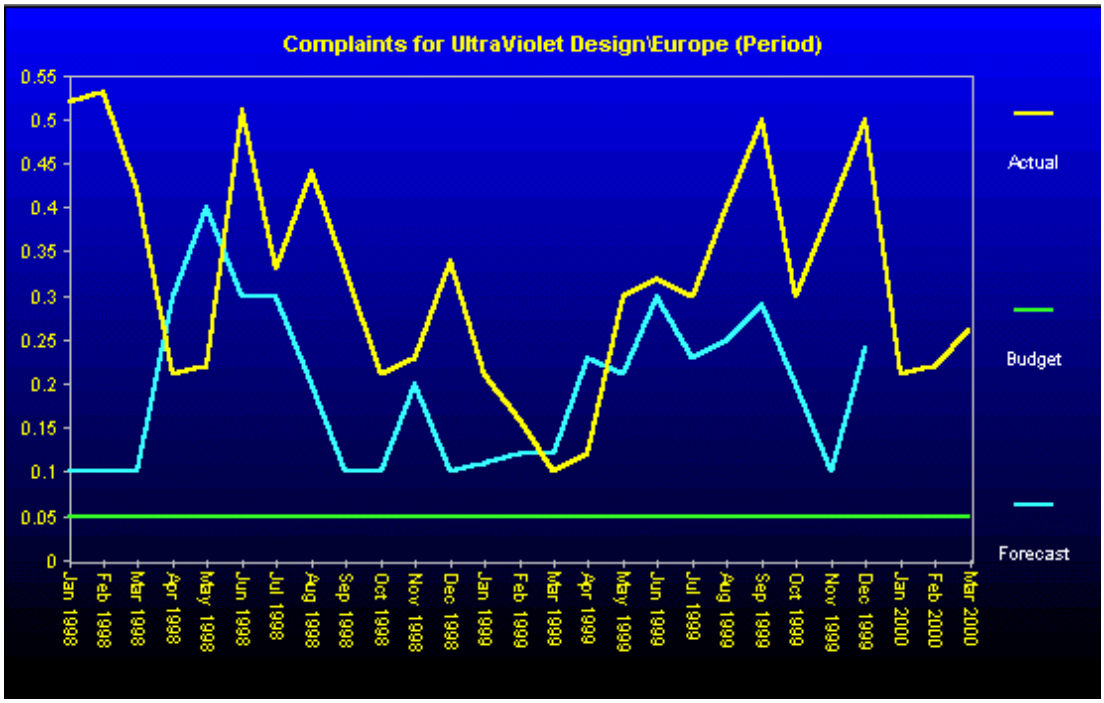
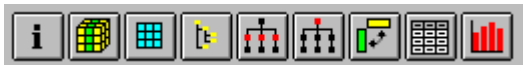


Figure 4-1 - KPI Graphical Screen

In the case of the KPI Graphical Screen, the Button Bar will provide additional user options, which are illustrated in figure 4.34.



1 2 3 4 5 6 7 8 9

Figure 4-2 -Button Bar

These options are used to:

- show the structural information behind the KPI (1)
- select data from an existing non-KPI OLAP Cube (2)
- change the Periodicity, Modes and the range of Time Periods of the underlying Data Slice to be shown (3)
- navigate through the hierarchical structure of the Data Slices in the case of a non-KPI OLAP Cube (4, 5 and 6)
- transpose the X and Y Dimensions (7)
- switch between a tabular or a graphical representation (8)
- select the chart type and style (9)

4.2.5.2.2 KPI Reports and Manual Data Entry

Apart from the graphical representation of the KPIs, the KPI Graphical Screen also provides the functionality to create and maintain KPI Reports as well as to manually enter and maintain data in the KPI Data Slices.

Figure 4-1 - KPI Reports / Manual Data Entry

All three types of KPI Reports are maintained from here depending on the access rights: General, Organization and Private KPI Reports.
The Manual Data Entry Tool enables users to directly input data into a Data Slice document of the ADBS Library, which needs to be identified by the selected Organization unit, the KPI, Mode, Year and Periodicity.
Furthermore, KPI Editors are authorized to change existing KPI data through the ADBS Application.

4.2.5.3 Analysis and Actions

The Analysis and Action pane contains the Executive Summary Analysis and Actions for a selected Organization unit and the KPI Analysis and Actions for a selected KPI in the Balanced Scorecard.

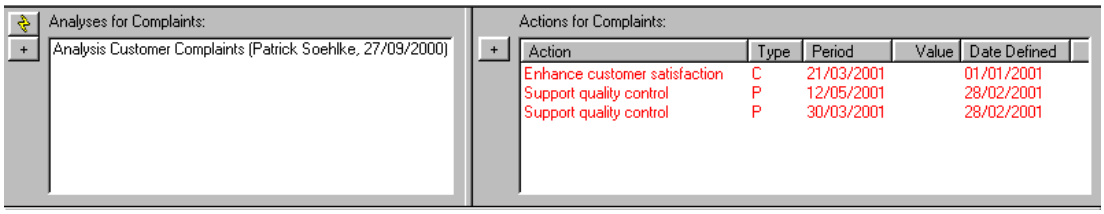


Figure 4-1 - Analysis and Actions

Analyses are shown with the title, author and creation date while Actions are shown with title, type (Corrective, Preventative, Breakthrough), period, value and creation date.

The Analysis and Action pane is a vital part of the Action Management Process, which is described in the following chapter.

4.2.6 ADBS Library – Knowledge Library and Administration

The overall process of the ADBS system includes two further parts of the ADBS Library, which are explained in the following paragraphs: the Knowledge Library and the Administration component.

4.2.6.1 Knowledge Library

The Knowledge Library is an additional graphical user interface for business users and displays the Actions and Analysis as well as the resulting Key Learnings in Lotus Notes views. This part of the ADBS Library is also represented via a special navigator, which links to the three main areas: CSF/KPI Library, Action and Analysis and Key Learnings.

The CSF/KPI Library part contains several views of KPI General and KPI by org. document, which are specially adapted to the needs of business users rather than Org Admins or KPI Editors.

The Action and Analysis part provides a list of all Actions and Analysis and three special views only displaying Actions, which are used in the Action Management Process: the Action Attention List, the ‘All My Actions’ view and the ‘All Actions by Status’ view.

The last part of the Knowledge Library is the Key Learnings components, which holds the knowledge derived from the already processed Analysis and Actions.

Key Learnings are used to categorize the insights of what actions have been taken already, which of them have been successful and which have failed in the Action Management Process to enable managers to learn from past actions.

4.2.6.2 Action Management Process

The Balanced Scorecard lays its main focus on measuring key performance indicators according to the organization strategy and on determining the most critical areas of the organization. Traffic Light Exception Reporting supports business users in defining limits for these measures and in focussing on those areas that need attention. To enable managers to act immediately on these identified areas the ADBS system provides Action Management as a continuous process. The Action Management Process starts in the ADBS Application.

The critical areas in an organizational Balanced Scorecard can be easily found via the defined Traffic Lights colors, symbols and KPI value limits.

In order to get a detailed overview on a particular KPI a user switches to the KPI Graphical Screen, which allows a much deeper analysis of the current situation. The KPI Graphical Screen gives access to the available KPI Reports, to additional OLAP data and allows changes in the graphical representation of the KPI data.

The Analysis and Action pane can then be used to create an Analysis document on the Executive Summary level or on the KPI level to make the analysis results available to the relevant persons.

The Analysis document contains all necessary KPI or Organization unit information depending on the level on which it was defined as well as the data values and an explanation, which holds the analysis results and causes.

The Analysis document is further used in the Action Management Process as a basis for the respective Action documents, which are defined on the same level.

Action Documents are the key components of the Action Management Process. They contain the same KPI or Organization unit information as the Analysis documents but include various action-specific information.

There are three types of Action documents: Corrective, Preventative and Breakthrough, which all contain information about a due data, a responsible person and an overall status, which is effected by the statuses of the milestones described in the following.

Created by:	Patrick Soehlke/ShowBusinessSoftware	Created on:	27/09/2000
Type:	◉ C ○ P ○ B		
Due Date:	01/01/2001	Status:	INITIAL
Assigned to:	Patrick Soehlke/ShowBusinessSoftware		

Figure 4-1 - Action Information

A 'Root Cause Gap Analysis' section contains a list of root causes and their particular contribution to the overall gap of the measure.
Another powerful component of the Action document is the Milestone section, which consists of a list of tasks with their responsible person, due date, current status and aimed value. It is used to assign the necessary tasks to the relevant persons in the organization and to overlook their progress continuously.

#	What:	Who:	When:	Status:	Value:
1	Summary	Patrick Soehlke	21/03/2001	INITIAL	20

Figure 4-2 - Action Milestone

Action and Analysis documents both contain a Key Learnings section, which is described in the above paragraph.

4.2.6.3 Administration of the Balanced Scorecard Structure and Security

The Administration component of the ADBS Library is a central place to maintain the information and the security of the CSF/KPI Library, Organization structure and the ADBS Group documents. This way, ADBS and Org Admins are enabled to directly modify and maintain information and security on the core ADBS Library documents, which are further used to update all related documents.
A special Administration Navigator shows all available options: KPI Maintenance, Organization Maintenance and ADBS Group Maintenance as the first group and KPI by org. Security and Organization unit Security as the second.
The document information update functionality is processed via Lotus Notes Agents, which are specialized tools that allow automatic editing, adaptation and modification of documents in the backend part of the database.
The necessary change information for the respective agent is provided in the frontend of the Administration section.

KPI Maintenance allows administrators to change the KPI Name and the Organization unit of a particular KPI General document.
Organization Maintenance offers more sophisticated functionality and is used to change the hierarchy, organization name and alternative names of a particular Organization unit. Furthermore, the Organization units for the Cascading CSF/KPI functionality can also be modified through this option.
The ADBS Group Maintenance already effects the security of the ADBS system and is used to change the members of ADBS Group documents.
As described in the security model at the beginning of this chapter, the security of the KPI by org. and Organization unit documents can be directly changed by the Org Admins and is inherited into all related documents.
The KPI by org. Security option, the Organization unit Security option and the ADBS Group Maintenance option of the Administration section therefore allow a central administration and update of the entire security in the ADBS system.

5. Conclusion, outlook and valuation of the ADBS system

5.1 Conclusion

The thesis project described in this work had the main goal to summarize the development and concept of the Action-driven Balanced Scorecard system and to explain the underlying technologies, models and theories.
The project was initially started in 1999, when Lotus Development, IBM, Arthur Andersen Business Consulting, Origin and Show Business Software Ltd. were evaluating a potential customer project at Philips with the goal to develop a Performance Management and Balanced Scorecard application that would suit the specific needs of a large organization.
The resulting requirements soon made clear than the amalgamation of two very different technologies would make the most sense: Groupware and OLAP.
The Arthur Andersen Best Practice Study as well as the initial Balanced Scorecard approach by Kaplan and Norton lay the economic foundation of the ADBS system, which was soon further developed and extended.
The Action Management part of the ADBS system as one of the main extension using Groupware specific features in connection with the Traffic Light functionality offers a unique possibility for organization to quickly locate and act on the critical organizational areas.
Furthermore, the built-in OLAP technology allows detailed analyses and integration of relevant business data and reduces the cost of data collection, preparation and delivery enormously.
This work focuses on the Lotus Notes version of the Action-driven Balanced Scorecard, which was initially planned and built before using the strong Web capabilities of the Lotus Domino Server.
The ADBS Web version is not subject to this work, however, a short description and an illustration of the application can be found in the appendix.

5.2 Valuation and Outlook

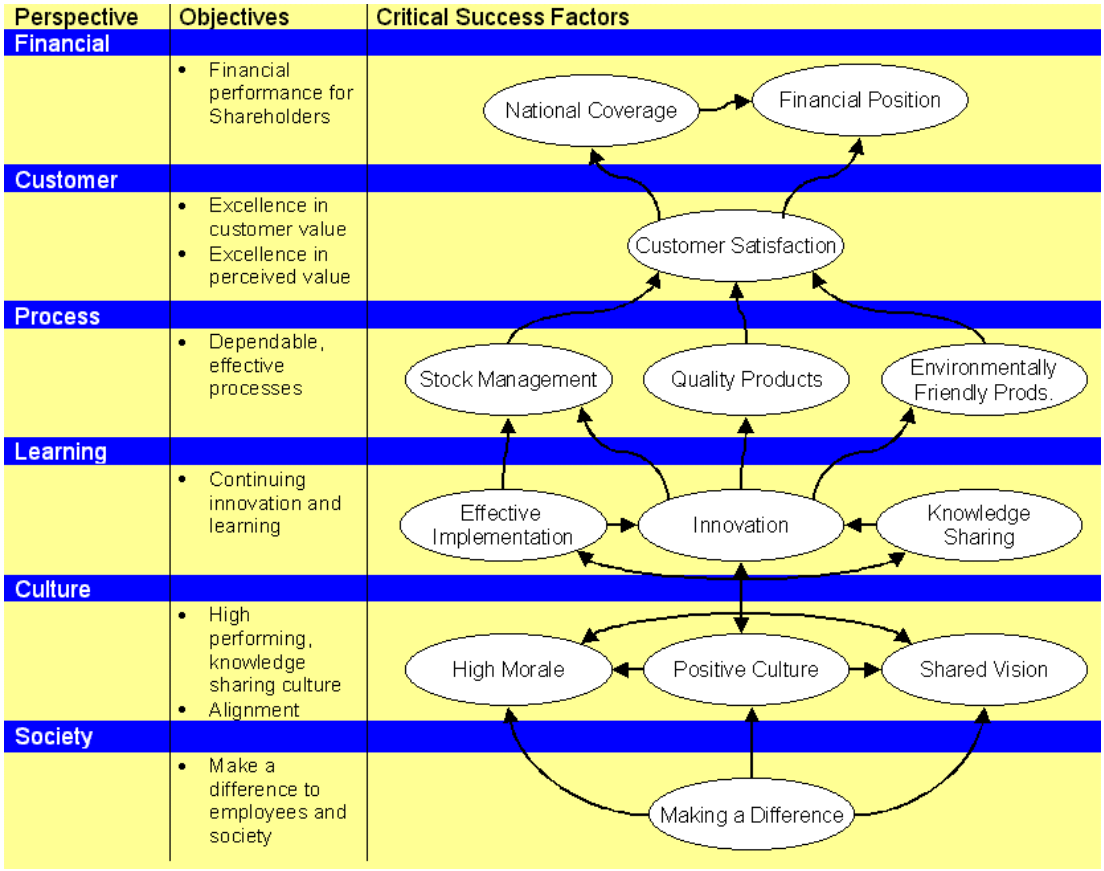
The main challenge of the ADBS system development was the combination of the Groupware features security, distributing and sharing of information with the strong aggregation, analysis and calculation capabilities of the OLAP technology.
This was achieved through the individual handling of two main information categories, data and structural information, and the combined representation in the ADBS Application.
Groupware technology was consequently applied in the case of ‘soft’ strategic and organizational information and OLAP in the case of ‘hard’ business data.

Data Integration was another area of attention and relies in this version of ADBS on the strong capabilities of Lotus Notes and other similar tools.
Enterprise Integration capabilities in Lotus Notes will be consequently extended in the next version of the software so that Lotus Notes views will work as a direct link to the external data sources in the future, which will allow the Cuber Application to directly access the relevant data sources.
The usage of interface modules in the ADBS system to connect to available Lotus Notes applications is for the time being limited to the integration of the Name and Address Book and an external organization structure.
However, the Action Management Process and the Key Performance Indicators are only two areas of the ADBS Library that could be used as the basis or as the starting point for Project Management and Workflow applications.
Concerning the KPIs in the CSF/KPI Library, several ideas of further development were raised during the completion of this work.
The key components of the Balanced Scorecard, the Perspectives, Strategic Goals, Critical Success Factors and Key Performance Indicators are not only hierarchically interconnected but also interdependent across hierarchical levels or on the same level. (See linkage diagram in the appendix.)
ADBS only allows a static representation of the influences between KPIs, which is planned to be dynamic and deeply embedded into the KPI by org. document in the next release.

This feature will go hand in hand with weighting and scoring of different KPI factors that result into a single KPI and allow for more complex definitions of BSC measures.
This way, sophisticated calculations of KPI values and the integration of economic formulas also become subject to further development.
As described in the second main chapter, Balanced Scorecard is only one of the main initiatives to enable organizations to become more effective.
Knowledge Management is a closely related discipline and has its main focus on locating ‘know-how’ in the form of information and people inside an organization.
Lotus Development Corporation as a key player in this arena seeks to develop powerful applications to support organizations in achieving this goal.
As a part of this initiative, direct communication via Lotus Sametime is meant to be a crucial component of the ADBS system as well as the closer integration of the ADBS system into the Lotus Knowledge Management Portal K-station.

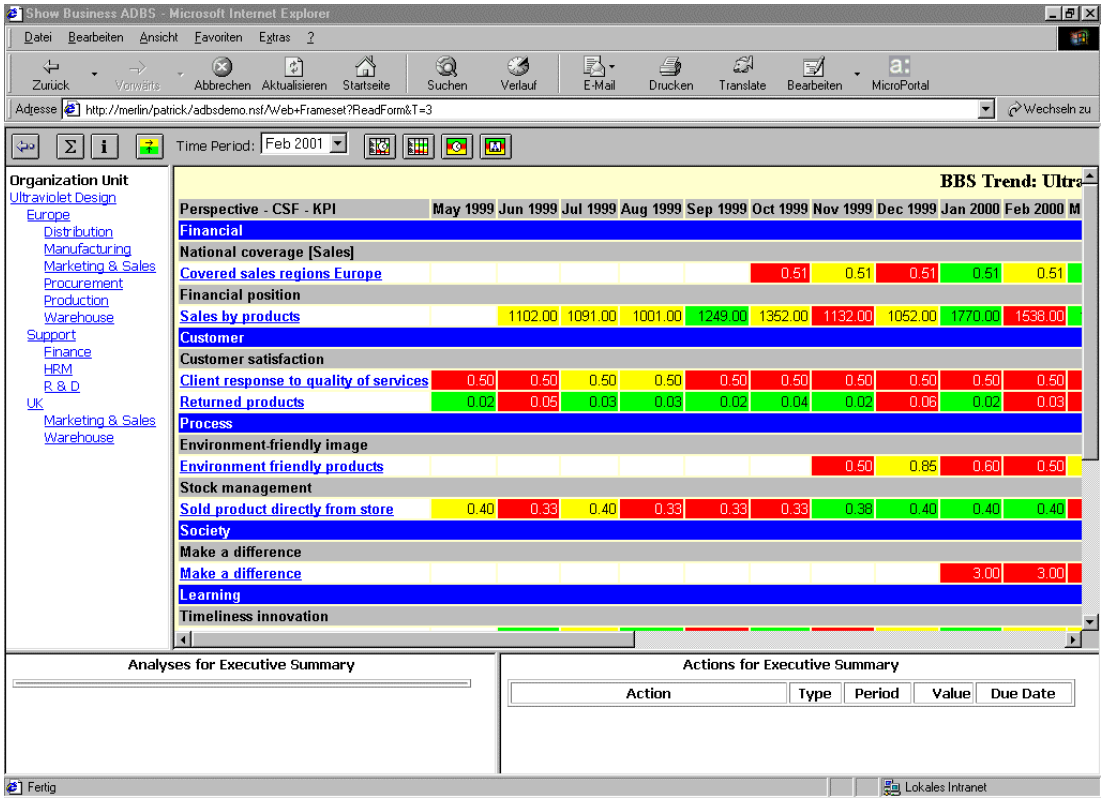
Appendix

A-1 Linkage Diagram



The linkage diagram shows the interdependence of Critical Success Factors and contained Key Performance Indicators across and inside the Balanced Scorecard Perspectives. The ADBS system currently allows a static representation of the interconnections, which will be extended to be dynamical in a future version.

A-2 ADBS Web Version



The above screenshot shows the ADBS System enabled for the use in standard Web Browsers, e.g. Microsoft Internet Explorer or Netscape Navigator.

A-3 ADBS Programming

ADBS Library

Programmed and designed by Patrick Söhlke and David Reid in co-operation with Show Business Software, Arthur Andersen Business Consulting, Philips Corporation and Origin.
The following ADBS Library components were programmed by the author of this work:

- Configuration
- Install Software
- Organization Structure
- CSF/KPI Library
- ETL
- Administration
- Knowledge Library

The programming includes the integration of the existing and modified Cuber Application and the newly created ADBS Application.

ADBS Application

Programmed and designed by David Reid in co-operation with Show Business Software, Arthur Andersen Business Consulting, Philips Corporation and Origin.

Cuber Application

Programmed and designed by David Reid in co-operation with Show Business Software.

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Eidesstattliche Erklärung

Ich erkläre hiermit an Eides statt, daß ich die vorliegende Arbeit selbständig und nur unter Verwendung der angegebenen Hilfsmittel angefertigt habe; die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht.

Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

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