

MULTIDIMENSIONAL MODEL FOR THE MASTER BUDGET

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Abstract: *In a dynamic business environment characterized by extreme competitiveness and the need to quickly adapt to new and changing market condition, information has become an asset. Timely and quality information are the basis for quality decisions, and only quality decisions help survive and prosper on the market. Business intelligence applications help the management take quality decisions. Business Performance Management applications steer the entire organization in the same direction, enabling the organization to translate strategies into plans, monitor execution, and provide insight to improve both financial and operational performance. A BPM implementation often combines financial with non-financial metrics that can identify the health of an enterprise from a variety of perspectives. BI and BPM applications implement multidimensional models, powerful models for data analysis and simulation. The present paper describes a multidimensional model that supports the construction of the master budget of an enterprise with simulation facilities.*

Key words: *business performance management; business intelligence; planning; budgeting*

1. Business Performance Management

Wayne Eckerson from The Data Warehousing Institute defines BPM as being “a series of processes and applications designed to optimize the execution of business strategies”, while Lee Geishecker, research director of the well-known research institution Gartner Inc defines BPM as being a set of „ methodologies, metrics, processes and systems used to monitor and manage an enterprise’s business performance”.

The term *Business Performance Management – BPM* is synonym with the terms *Corporate Performance Management - CPM* , *Enterprise Performance Management - EPM* and means steering the organization in the same direction by allowing the transformation of strategies in plans, monitoring the plans execution and offering detail information on the organization evolution for improving the enterprise’s operational and financial performances. A BPM implementation combines financial with non-financial metrics in order to identify the degree of health of the economic organization from a variety of perspectives.

A BPM software solution contains standard components such as:

- Planning, budgeting and forecasting: components that allows defining plans, creating budgets and forecasts;

- Financial and statutory consolidation: a component that allows realizing the consolidated balance sheet at the level of a group of companies belonging to the same holding;
- Scorecarding: a component that allows defining performance metrics and dashboards;
- Reporting and analysis;
- Business Intelligence (BI).

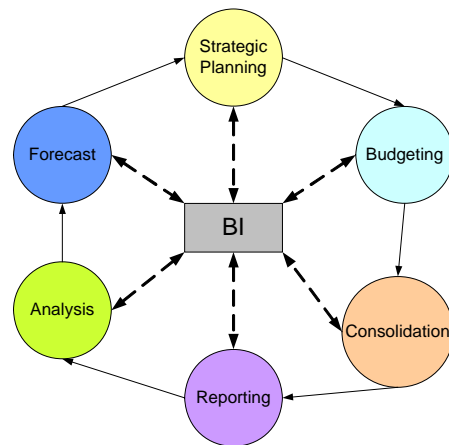


Figure 1. The BPM process

2. Planning, budgeting and forecasting

A *budget* is the translation of strategic plans into measurable quantities that express the expected resources required and anticipated returns over a certain period.

As defined in [8], there are several types of budgets:

- *Short term* (month to month, year to year) versus *long term* budgets (5 years);
- *Fixed versus rolling budgets*. A fixed budget covers a specific time frame, usually one fiscal year. At the end of the year a new budget is prepared for the following year. A rolling budget is a plan that is continually adapted so that the time frame remains stable while the actual period covered by the budget changes (for example: as each month passes, the one-year rolling budget is extended by one month so that there is always a one-year budget in place).
- *Incremental versus zero-based budgeting*. Incremental budgets extrapolate from historical figures: in determining the budget for the next period managers look at the previous period's budget and actuals (past figures are increased by a set percentage or by an absolute value). In zero-based budgets each new budgeting cycle starts from a zero base or from the ground up as though the budget were prepared for the first time. Zero-based budgets require managers to perform a much more in-depth analysis of each line item.

The budgeting process produces the *master budget*. The master budget brings all the pieces together incorporating the *operating budget* and the *financial budget*:

- the *operating budget* consists of budgets from each function (research and development, production, marketing, distribution, customer service) and provides the budgeted income statement;
- the *financial budget* includes capital budget, the cash budget, the budgeted balance sheet, the budgeted cash flow.

The master budget integrates operational and financial budgets and is created with an iterative process during which information flows back and forth from each element of the master budget.

Planning is a strategic prediction of business performance at a summary level. Plans are defined by senior managers who help the company respond to changing market conditions and opportunities. The process is frequent and must be completed quickly.

Budgeting is planning distributed to individual areas of responsibility across the business. Many more people are involved in the process and the work is done at a greater work of detail. Budgeting is a slow process, often taking weeks and performed once or twice a year.

Forecasting is a revision of the budget (sometimes in at a summarized detail) to reflect changing market conditions, strategic plan alterations, error corrections, revised assumptions in the original approved budget. Organizations typically re-forecast monthly; a handful of finance personnel take part in the process.

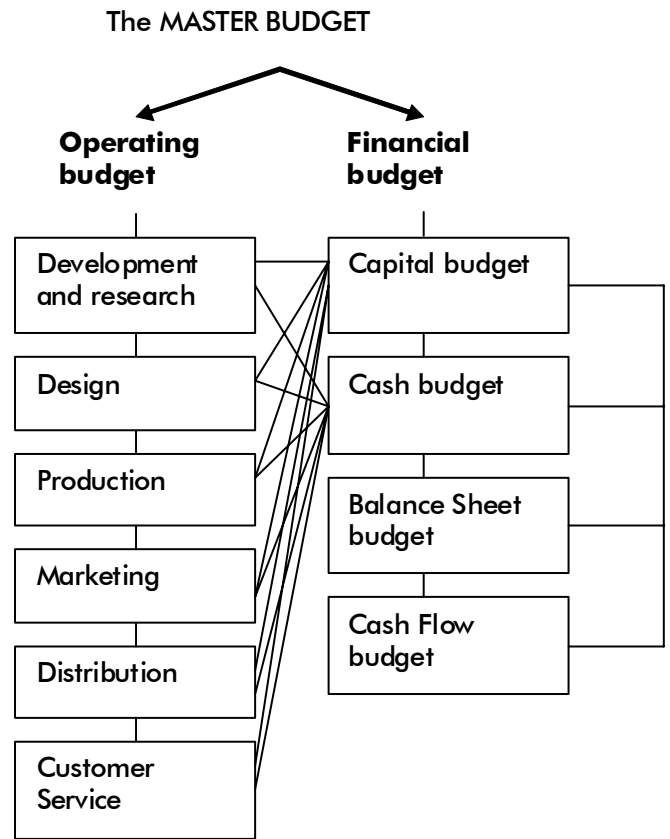


Figure 2. The Master budget components

Table 1. Planning, budgeting and forecasting (source: [8]²)

	Frequency	Speed	Detail level	Personnel involved
Planning	Often	Quick	Summary	Senior management
Budgeting	Annual	Slow	Highly detailed	All departments
Forecasting	Monthly	Quick	Summary, light detailed	Finance

Budgeting performs 4 basic functions, each critical to a company in achieving its strategic objectives: planning, coordinating and communicating, monitoring progress, evaluating performance.

Planning, budgeting and forecasting are the most important management functions. Their main purpose is to enable senior managers to see the financial implications of various business scenarios. It is a continuous and rapid cycle that provides a near-real-

time response and the most likely business plan scenario becomes the target for the upcoming budget cycles.

Every year companies invest substantially to create comprehensive plans, an annual budget and several forecasts, spending heavily for specialised software, staff overtime and temporary help for data entry. Of these, budgeting it is the most difficult task. Senior managers, accountants, financial analysts, department managers spend countless hours in budget preparation, revision and consolidation. The overall result is as follows:

- organizations spend more time creating a budget than analyzing it;
- most times the budget bears little or no relation to the organization's business plan;
- after the budget it is approved no one looks at it again;
- budget holders dislike very much the tedious and lengthy process of creating, revising and submitting documents;
- budget holders usually attribute adverse variances to the finance department and favourable variable to their own performances and managerial skills. The practice is known as *slack* or *padding* and it occurs when managers believe they are going to be evaluated on their performance relative to budget. To ensure that they will achieve their budgeted figures and be rewarded, the budget revenues conservatively or exaggerate costs or do both.

Most companies use spreadsheets as main budgeting tool. Though spreadsheets are personal productivity tools, they have numerous shortcomings that prevent them from adequately manage a budgeting process of any significant size or sophistication:

- spreadsheets are two-dimensional while budgeting itself is a multidimensional process (example: budget revenue by customer, product, period, version etc);
- spreadsheets are very hard to maintain. Speed and ease in updating a budgeting model is essential for staying abreast of business change. A simple change (adding a cost centre, a department) can mean updating hundreds of spreadsheets and macros.
- Spreadsheets don't integrate well with other systems. A spreadsheet is a single-user tool. With spreadsheets is difficult to share data with other systems (ERP's , OLTP's);
- Spreadsheets models are difficult to share. A spreadsheet is a single-user tool. With spreadsheets is difficult to share data among different worksheets and workbooks. Building a spreadsheet-based solution that consolidates input from multiple users is tedious, time-consuming, very difficult to change and maintain.
- Spreadsheet models are hard to understand: chasing cell references around a spreadsheet or workbook to understand one formula is a frustrating process.

Software solutions for budgeting have to provide flexibility to accurately model the business, support multiple users, easily adapt to rapid change. Budgeting software solutions have to address the disadvantages of spreadsheets-based systems:

- should support multidimensional budgeting;
- allow fast adaptation to changing constraints, assumptions and structures;
- have data import and export functionalities;
- be easy to use for non-programmers (business users should be able to build their own models with IT department intervention);
- should allow calculations for simulations and what-if scenarios.

Leaders on the BPM market, all software providers offer planning, budgeting and forecasting solution:

- Hyperion Solutions (bought by Oracle in 2008) has Hyperion Planning;
- Cognos (bought by IBM in 2008) has Cognos 8 Planning;
- SAP has SAP SEM Intelligence (BPS);

3. Multidimensional models

A model is an abstraction of the real world. Models allow business analysts to give a form, a shape to the unknown concepts and realities. The goal of a data model is to represent in an exhaustive manner the data and information of an organization.

Legacy or OLTP (On-Line Transaction Processing) systems are the organization's operational systems: they are transaction oriented and used to managing day by day activities (input or update of orders, sales, inventory, accounting records etc). These systems use databases that implement relational models in a normalized form. A relational model is composed by:

- Entities: are objects the organization needs to analyze.
- Relationships: describe the way entities interact with each other.
- Attributes are characteristics of the entities.
- Operations such as insert, delete and update are very fast due to the normalized form of the database that allows minimum redundancy.

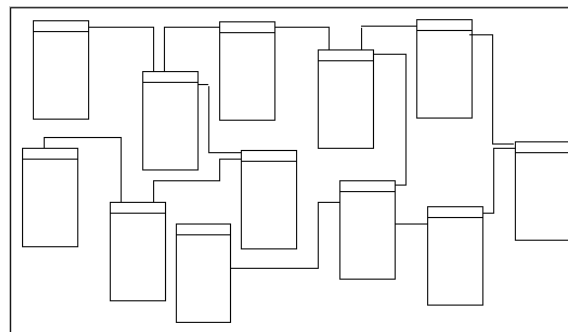


Figure 3. The relational model

Things are not as easy with data retrieval in a relational model. Retrieving the information of a query (the best sold products on all markets during the last 3 months) usually involves joining of more tables in order to find all the necessary data (in real applications joins of 10 - 20 tables are very common). The more tables involved in the query, the more data in every individual table, the more the aggregations to make (calculations like sum, average, count etc), the longer it takes to the query to retrieve the final result. The relational model is not fit for querying. The solution to this problem is a multidimensional model.

The multidimensional data model enforces simplicity by giving up to the minimum redundancy: opposite to the relational model, the multidimensional model is highly de-normalized. De-normalization and redundancy contribute to quick retrieve time because the information doesn't have to be built up from a large number of tables connected by joins.

A multidimensional model is made of two types of tables:

- A fact table: containing the measures, elements that are subject to analysis (sold quantity, price) and on which the query is build;
- Dimension tables: containing the elements on which data is to be aggregated, the analysis axis of the data (product, client, market etc).

The dimension tables (de-normalized) are linked to the fact tables with foreign key forming a star-schema. Sometimes the dimension tables are further normalized by eliminating the low-cardinality attributes in separate tables: the result is a snow-flake schema. When multiple fact tables share common dimensions we have a multi star schema.

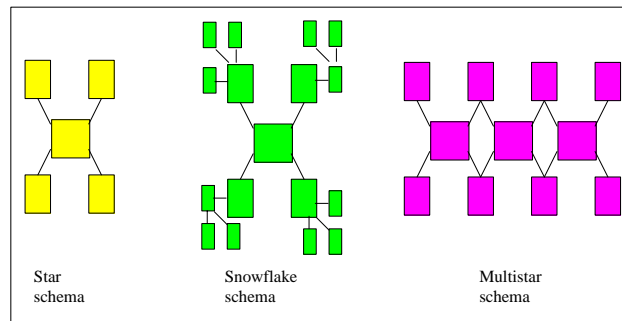


Figure 4. Multidimensional models

A star-schema forms a structure called cube. Despite its name which is a direct expression of the limited capacity of the human brain for space representation, a cube is made of n dimensions.

Dimensions are the analysis axis of data and they are made up of members organized in hierarchies based on father - child relationships. A cube contains a cell for any member combination of its dimensions.

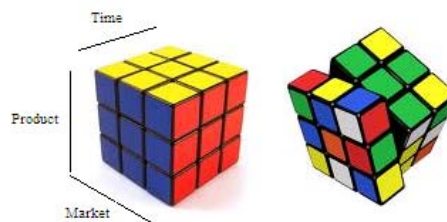


Figure 5. Rubik's cube: a 3 dimensional cube

One of the dimensions is the measures dimension: measures are the key performance indicators that the business analysts want to evaluate. To determine which of the numbers in the data might be measures, the rule to follow is: if a number makes sense when it is aggregated, then it is a measure. For example, it makes sense to aggregate daily volume to month, quarter and year. On the other hand, aggregating names or addresses would not make sense; therefore, names and addresses are not measures. Typical measures include volume, sales and cost.

The hierarchies and the dimensions allow the business analyst to slice and dice the cube according to its needs during data analysis. The cube draws its power from the fact that aggregation (total sales per quarter, per total market, per total client etc) is already calculated and the queries against the cube are very fast in response.

By multidimensional operations (drill up, drill down, pivoting, filtering) the business analyst can slice and dice according to his needs for better understanding of data.

4. Problem analysis

Multidimensional models facilitate and allow fast simulations and what-if analysis through the support they offer in implementing multiple scenarios of ,best case' and ,worst case' type.

The paper presents the case of a Romanian steel producing company with subsidiaries in Galați, Iași, Hunedoara and which sells steel products to national and international clients. The applications was developed used Hyperion Planning 9.3.1.

Here there are some cascading questions a steel production company could make during it's planning and forecasting process. Let's suppose the company has in plan to sell 100.000 tones of steel next year.

1) What if instead will have to sell 150.000 tones or 70.000 tones of steel (because it gains new clients or loses some of its old clients)? What's the impact on the production capacity and the workforce? In order to produce more: it would have to make new hires or buy new assembly lines and ovens? More raw materials would be needed?

2) What if the petrol price will increase? What if the price of the raw materials will increase? What if the Euro – Dollar rates will increase or decrease? What would be the impact on the final price for the client?

The analysis dimensions of the steel company are:

- Year: the years of planning and forecasting;
- Period: with months grouped in quarters (budgets and forecasts are made at a monthly level);
- Scenario: can be Budget, Forecast, Actual (an actual scenario allows comparison with real actual data and helps define the budget);
- Version: version 0, version 1, version 2, version 3 etc (for managing several versions of Budget and Forecast till the final approved ones);
- Client: a dimension containing the company's clients grouped in National clients and International clients;
- Product: steel pipes, tubes of certain length, thickness, hollow section, weight, shape, raw material composition.

The sale price of a tone of steel per product has several components:

- Base price: it is the price that represents the cost of the raw materials that participated in creating 1 tone of product;
- Extra price: it is calculated monthly. For producing stainless steel special metals, with very dynamic prices are used. These metals are nickel, chromium and molybdenum. The extra-price reflects the price of these metals on the stock market and it is influenced by the Euro-Dollar exchange rate.
- Transportation price: is the cost of transportation;
- Other price: other costs in producing steel.

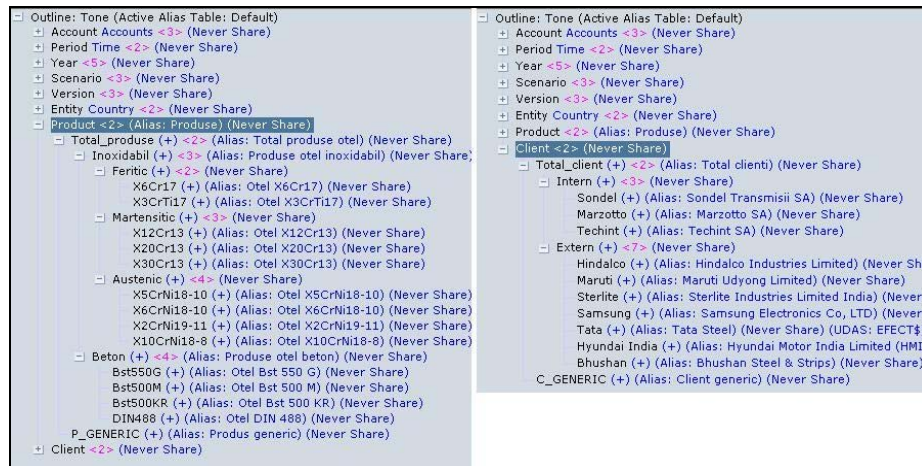


Figure 6. Product and Client dimensions

The simulation needs are the following:

- **Tons:** what happens with revenues if the society sells an extra tons amount to a certain client, for a certain product, on a certain period or a combination of clients, products and periods?
- **Base price:** what happens with revenues if the base production price increases or decreases by a certain amount for a certain client, product, period or a combination of clients, products and periods?
- **Extra price:** what happens with revenues if the extra production price increases or decreases by a certain amount for a certain client, product, period or a combination of clients, products and periods?
- **The dollar effect:** how does the Euro-Dollar exchange rate affects the price components (base, extra, transportation, other) and what's the effect on the final revenues?

The selling prices are in Euros. The Euro-Dollar exchange rate affects only certain clients (external clients who operate in dollars) on all price components. For clients buying in Euro, the Euro-Dollar exchange rate affects only the extra price.

VAT is calculated only for Europe and simulations on base price and extra price are done only for products that contain nickel.

The phases for realizing plans, budgets and forecasts are:

- A. Based on the historical and new contracts the company has with its clients, the commercial department performs an initial prediction for tones to sell to the clients and the selling prices. The prevision is made for tons and price components (base price, extra price, transport, others) for every combination of clients and products, for every month of the year.
- B. The planning and controlling department, based on the initial prediction received as input from the commercial department and based on other parameters (the VAT percent, the Euro-Dollar rate) performs a prediction of the profit and loss account "sold production". Based on the payment conditions (the number of days the client pays), from the profit account "sold production" the balance sheet account "payments receivables" is calculated. The controlling department also estimates the remaining profit and loss and balance sheets accounts.

The profit and loss accounts impact on the balance sheet accounts. Part of the balance sheet accounts are calculated using automatic routines from the profit and loss accounts. For example, "payments receivables" can be automatically calculated from the "sold production" account.

- C. The financial department performs simulations and what-if analysis on number of tones sold, the price components, the VAT percent, the evolution of the Euro-Dollare exchange rate. The simulations have a direct effect on the profit and loss account and the patrimonial state of the organization. Simulations are performed in different simulation versions, any simulation version will display it's own profit and loss account and patrimonial state.

5. Multidimensional model design

The prediction of the commercial activity is done at a detail level of year, scenario, version, subsidiary, product, client. The profit and loss and balance-sheets accounts are predicted at a level of detail of year, scenario, version and subsidiary. The different level of granularity for the two activities conduct us to build an application made up of two cubes:

- one cube for predicting the sold production where simulations on tones and prices are to be executed (cube Tons).
- one cube for the master budget made up of the Profit and Loss account and the Balance Sheet (cube MstBdg).

The facts for cube Tons are: tons, prices (base price, extra price, transport, other), sold production, gross revenue, net revenue, client credits.

The facts for cube MstBdg are the accounts in Profit and Loss and Balance Sheet.

The sold production and client credits calculated in cube Tons (granularity: version, subsidiary, month, client, product) feed with automatic routines the members sold production and payment receivables in the MstBdg cube (granularity: version, subsidiary, month).

Table 2. Dimensions for cubes Tons and MstBdg

Dimensions in cube Tone	Dimensions in cube MstBdg
Measures (account)	Measures (account)
Hierarchy „parametri“	Hierarchy „Contul de profit si pierdere“
Hierarchy „masuri vanzare“	Hierarchy „Bilant contabil“
Year	Year
Scenario	Scenario
Version	Version
Period	Period
Entity (subsidiary)	Entity (subsidiary)
Client	-
Product	-

5.1. The Tons cube

It's goal is to calculate sales value derived from selling tons of different products to different clients. The calculus is performed at a very detailed level (month, product, client). The cube allows fast simulations on tons and prices.

The simulation problem exposed above can be very easy and elegantly solved by choosing the appropriate structure of the account (measures) dimension. The analyst has to design the accounts dimension so that he can fully leverage the potential of the multidimensional calculation engine. In order to satisfy the simulation needs presented above, the appropriate facts structure is presented in the figure below:

Account Accounts <3> (Never Share)
<ul style="list-style-type: none"> Parametri (~) <4> (Alias: Parametri de simulare) (Never Share) (UDAS: Saved Assumption, Flow) <ul style="list-style-type: none"> TVA% (+) (Alias: Procent TVA) (Never Share) (TB Average) (UDAS: Saved Assumption) rata_schimb (+) (Alias: Rata schimb Dolar-Euro) (Never Share) (TB Average) (UDAS: Saved Assumption) efect_\$ (+) (Alias: Multiplicator pentru efectul dolar) (Dynamic Calc) (TB Average) (UDAS: Saved Assumption) [Formula: IF param_zile_clienti (~) <5> (Alias: Numarul zile pt plata creditorilor clienti) (Never Share) (TB Average) (UDAS: Saved Assumption) Masuri_vanzari (~) <5> (Alias: Masuri pentru vanzari) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Tone (~) <2> (Alias: Tone otel (t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Tone_input (+) (Alias: Tone otel input (t)) (Never Share) (UDAS: Revenue, Flow) Tone_delta (+) (Alias: Tone otel delta (t)) (Never Share) (UDAS: Revenue, Flow) Pret_net (~) <2> (Alias: Pret net (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_brut (+) <3> (Alias: Pret brut (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_baza_eff\$ (+) <2> (Alias: Pret de baza cu efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_baza (+) <2> (Alias: Pret baza fara efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_baza_input (+) (Alias: Pret baza input (E/t)) (Never Share) (UDAS: Revenue, Flow) Pret_baza_delta (+) (Alias: Pret baza delta (E/t)) (Never Share) (UDAS: Revenue, Flow) M_efect\$_pret_baza (+) (Dynamic Calc) (UDAS: Revenue, Flow) [Formula: IF (@ISUDA ("Client", "EFFECT\$")) "M_ Pret_extra_eff\$ (+) <2> (Alias: Extra pret cu efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_extra (+) <2> (Alias: Pret extra fara efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Pret_extra_input (+) (Alias: Pret extra input (E/t)) (Never Share) (UDAS: Revenue, Flow) Pret_extra_delta (+) (Alias: Pret extra delta (E/t)) (Never Share) (UDAS: Revenue, Flow) M_efect\$_pret_extra (*) (Dynamic Calc) (UDAS: Revenue, Flow) [Formula: IF (@CURRMBR ("Version") == "Versiun Alte_preturi_eff\$ (+) <2> (Alias: Alte preturi cu efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Alte_preturi (+) (Alias: Alte preturi fara efect \$ (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> M_efect\$_alte_preturi (+) (Alias: Multiplicator efect dolar pentru alte preturi) (Dynamic Calc) (UDAS: Revenue, Flow) Transport_eff\$ (E/t) (-) <2> (Alias: Cost transport cu efectul dolar) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> Transport (+) (Alias: Costul transportului fara efect dolar (E/t)) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> M_efect\$_transport (*) (Alias: Multiplicator efect dolar pentru transport) (Dynamic Calc) (UDAS: Revenue, Flow) [Formu Venit_brut (~) (Alias: Venit brut fara TVA (E)) (Never Share) (UDAS: Revenue, Flow) Venit_brut_TVA (~) (Alias: Venit brut cu TVA (E)) (Never Share) (UDAS: Revenue, Flow) Venit_net (~) (Alias: Venit net (E)) (Never Share) (UDAS: Revenue, Flow) Masuri_temporare (~) <2> (Alias: Masuri cu caracter temporar pentru calcule) (Never Share) (UDAS: Revenue, Flow) <ul style="list-style-type: none"> credit_grup (+) (Alias: Credite generate de societatile interne) (Never Share) (TB Last) (UDAS: Asset) credit_terti (+) (Alias: Credite generate de terti (extern)) (Never Share) (UDAS: Revenue, Flow)

Figure 7. Accounts dimension for cube Tone

Level 0 members are members that don't have children. Data is usually inserted at level 0 member combinations.

Aggregated or upper level members are members that have children. The upper level members are automatically calculated in base of the lower level members and their consolidation operation. The consolidation operation can be:

- (+) Adds the member to the result of previous calculations performed on other members (is the default operator);
- (-) Multiplies the member by -1 and then adds it to the sum of previous calculations performed on other members;
- (*) Multiplies the member by the result of previous calculations performed on other members;
- (/) Divides the member into the result of previous calculations performed on other members;
- (%) Divides the member into the sum of previous calculations performed on other members. The result is multiplied by 100 to yield a percentage value;

(~) Does not use the member in the consolidation to its parent.

For example:

$$(1) \text{ pret_baza_efect\$} = \text{pret_baza} * \text{M_efect\$_pret_baza};$$

and
$$(2) \text{ pret_baza} = \text{pret_baza_input} + \text{pret_baza_delta};$$

Hierarchy 'Parametri' contains:

- 'TVA%' indicates the VAT percent (is fixed for a scenario, cannot vary from one version to another);
- 'param_zile_client' indicate the client paying conditions (number of days the client pays the products he bought) ;
- 'rata_schimb': the user saves in this member the Euro-Dollar exchange rate for the current version of simulation.
- 'efect_\$': is automatically calculated by the system and indicates the dollar effect multiplier.

$$(3) \text{ efect_\$} = \text{Euro-Dollar exchnge rate of version stasrt} / \text{Euro-Dollar exchange rate in current version.}$$

Hierarchy 'Masuri_vanzari' contains members of type:

- input type members (tone_input, pret_baza_input, extra_pret_input, transport, alte preturi) are filled in the start version (version_0) of the BUDGET scenario with the budget data provided by the commercial. This data is the basis for simulations.
- delta type members (tone_delta, pret_baza_delta, extra_pret_delta) are used in simualtions on tones on prices (tons sold increase/decrease by certain tons, base price and extra price increase and decrease by a certain amount).
- dollar effect multiplier members indicate the effect of the Euro-Dollar exchange rate on the price component.
- Gross and net revenues.

Any final price component is calculated with the formula:

$$(4) \text{ price cu efect dolar} = \text{pret fara efect dolar} * \text{multiplicatorul efect dolar};$$

The account structure forms the net price as follows:

$$(5) \text{ pret net} = \text{pret brut} - \text{Transport cu efect dolar} \\ = (\text{pret baza cu efect dolar} + \text{pret extra cu efect dolar} \\ + \text{alte preturi cu efect dolar}) - \text{Transport cu efect dolar.}$$

Hierarchy 'Masuri_temporare' contains members:

- credit grup
- credit terci

that are used in order to calculate client credits resulted from selling products to clients. The calculation of client credits is done based on the contractual paying conditions (the number of days after delivery in which the client performs payment), conditions expressed with the member 'param_zile_client'.

For simulation, the business analyst could follow the following steps:

Step 1. Start simulation in version_0

The commercial office of the organization provides an initial version of the budget by inputting into the system:

- Tons and prices (base, extra, others, transportation) for all the combination of products, clients, geography and months;
- The VAT percent.

Step 2. Simulations in version_n

- 2.1. In order to keep clear the start data, data in version_0 is copied into version_n. Multidimensional software solutions contain data copy functionalities.
- 2.2. The business analyst inserts new exchange rates for the simulation version and the system automatically calculates the dollar effect multiplier.

Step 3. The user simulates tons and price variations in the delta type members by launching specific business rules for simulations. The business rule are parameterized calculation scripts that write down values into the delta members

Step 4. The database is calculated by launching a calc script that calculates various revenue as tons * price.

Multidimensional software contain easy to use scripting languages that allow implementation of calculations (business rules).

Step 5. Using a front-end tool to interrogate the cube, the user can investigate the result of the simulations.

Gross revenues on the simulation versions have changed due to changes of the Euro-Dollar rates, the extra-tons sold and the increase of the base price.

5.2. The Master Budget cube

Its main goal is to offer support for realizing the predicted *Profit and Loss* and the *Balance Sheet*.

The account dimension contains two hierarchies:

- the Profit and Loss hierarchy accounts ("Contul de profit si pierdere");
- the Balance Sheet hierarchy accounts ("Bilantul contabil propriu-zis").



Figure 8. Accounts dimension for cube Master Budget

The account „Productia vanduta” (sold production) is imported from the Tons cube with an automatic routine (the corresponding fact is „Venit brut”) at an aggregated level of total product and total clients.

Account „Creante comerciale interne” and „Creante comerciale externe” are imported from the Tons cube using automatic routines (the corresponding facts are „credit_grup” and „credit_terti”) at an aggregated level of total product and total clients.

Very version of the MstBdg cube contains the effect of the simulations performed on the same version in the Tons cube.

6. Conclusions

Multidimensional cubes are a powerful instruments for analyzing huge volumes of data. Regardless of the software used to create multidimensional applications (Hyperion Essbase, IBM Cognos, SAP BW etc), multidimensional analysis draws its power from the following elements:

- The possibility to easily analyze the data by slicing and dicing;
- Calculations are easy to implement;
- Aggregated data is already pre-calculated (that implies a fast response time for queries).

Multidimensional models are used both in analyzing current data and as a support in planning and forecasting processes. The application designer has a major role when designing a multidimensional model for simulations. Designing a multidimensional cube is more than simple work; it can be seen as art considering that an efficiently designed account structure solves a lot of the simulation issues (especially calculations) and saves the model from future re-designing in order to adapt it to new needs and requests.

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