BUSINESS PLANNING AND FORECASTING APPLICATION FOR
SYNOPSYS, INC.

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ABSTRACT

BUSINESS PLANNING AND FORECASTING APPLICATION FOR SYNOPSYS, INC.

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Business/Financial Planning is an integral part of the management cycle. Companies are situated in complex environment like different geographical environment, political situation, competitive landscape, etc. Different companies follow different business models (such as public sector vs. private owned companies). Depending on their overall company goal (increasing operating margin, increasing earnings, decreasing expenses etc.), companies formulate plans to achieve those goals in an efficient manner. To achieve these goals, executives in a company need to make timely and well-educated business decisions. To make these decisions executives of a company need information on expenses, earnings, assets, employees etc. To maintain edge in this competitive environment companies not only need to make policies and decisions in the present environment, but also need to have clear vision for the future. This vision for future depends
on present information and projection of future information (i.e., simulation of business data for future time periods or planning for future).

Planning supports decision making, coordination of different divisions in company towards achieving common goal. Business Planning helps identify the means and ways for optimal operational efficiency. Reporting based on planning tracks all transactions incurred by execution process. Analysis as part of business planning focuses on calculating success of objectives achieved and seeks out reasons for any deviations. The result of the analysis is measured against the company mission and leads to an evaluation of overall goals and actions to be taken in order to steer the course.

Primary objective of this project is to implement a comprehensive financial planning system for Synopsys, Inc. BW-BPS application will be used to address the existing FP&A (Financial Planners and Analyst) pain points and provide capability to drive flexible planning processes. This system will be used to do planning primarily in two areas, employee planning and expense planning, with flexibility to extend it to sales planning, depreciation planning, profit and loss planning. This system will incorporate cutting edge technologies in business intelligence and operational systems, as datasource and data warehouse for planning. Extensive OLAP capability of SAP BI system will provide a comprehensive multidimensional reporting capability. This project will help Synopsys Inc to alleviate all the pain points’ associate with traditional planning in operational systems. It will greatly reduce the planning time, increase efficiency and accuracy. This application will provide a greater insight into the business data and also reporting on that data in multi-dimensional manner, thus giving different
views of the same data which will help executives in making well educated and timely business decisions.
CHAPTER I

INTRODUCTION

Business/Financial Planning is an integral part of the management cycle. Companies are situated in complex environment like different geographical environment, political situation, competitive landscape, etc. Different companies follow different business models (such as public sector vs. private owned companies). Depending on their overall company goal (increasing operating margin, increasing earnings, decreasing expenses, etc.) companies formulate plans to achieve those goals in an efficient manner. To achieve these goals, executives in a company need to make timely and well educated business decisions. To make these decisions executives of a company need information on expenses, earnings, assets, employees, etc. To maintain edge in this competitive environment companies not only need to make policies and decisions in the present environment, but also need to have clear vision for the future. This vision for future depends on present information and projection of future information, i.e. simulation of business data for future time periods or planning for future.

Planning supports decision making, coordination of different divisions in company towards achieving common goal. Business Planning helps identify the means and ways for optimal operational efficiency. Reporting based on planning tracks all transactions incurred by execution process. Analysis as part of business planning focuses on calculating success of objectives achieved and seeks out reasons for any deviations.
The result of the analysis is measured against the company mission and leads to an evaluation of overall goals and actions to be taken in order to steer the course.

**Purpose**

Primary objective of this project is to implement a comprehensive financial planning system for Synopsys, Inc, a leading provider of Electronic Design Automation (EDA) software and related services to semiconductor design companies [1]. BW-BPS [3] application will be used to address the existing FP&A (Financial Planners and Analyst) problem points and provide capability to drive flexible planning processes. Financial planning within Synopsys is primarily done in two areas: Employee Planning and Expense Planning.

**Employee Planning**

Employee planning is financial planning based on company’s employees. Employee planning answers questions like what is the number of current employees. How many will be hired in upcoming financial periods? How many were hired in previous planning cycles? How benefits will be calculated based on regions and countries? Employee planning will be used calculate all the benefits associated with employees and project the data in monthly/quarterly/yearly figures. There are many benefits associated with an employee, like corporate incentive plans, MBO (Management Business Objectives) bonus, spot bonus, Sales Bonus (when someone reaches or exceeds their sales targets), marketing bonus, performance bonus, general benefits, etc. This benefit for each employee needs to be calculated for current period and needs to be projected for future periods based on country and regions. In a multinational company,
these calculations have to be done based on different government rules, different currencies, and different HR policies for each country. This planning has to be done in a hierarchical manner starting with overall company and going down country, business units, cost center and individual employee.

**Expense Planning**

Expense Planning involves planning all the expenses within company. Any company incurs various expenses like car rentals, transportation, employee meals, entertainment, office supplies, bills, expense reimbursements, etc. All these expenses need to be monitored and planned to minimize the expenses. Depreciation of all the company’s assets also needs to be calculated to project the company’s assets accurately to investors and Wall Street. Any asset owned by company depreciates over a period of time until its end of life has reached. Accurate projection of company’s assets and its depreciation is necessary for accurate financial planning.

Financial planning gives executives ability to look at company’s finances from the lowest level like an expenses for individual employee to highest level like complete company’s expenses. It gives decision makers ability to drill down to each level and identify the anomalies and issues with business process and correct it to align the process with overall business objectives.

**Problems**

Financial Planning problems arise from restrictions and due to limitations in current SAP Enterprise Resource Planning system. Some of the current process pain points that this project needs to address are - issues related to FX (Foreign Currency
Translation) currencies and translations, constant manual validation, TBH (To-Be-Hired) process, multi year forecasting, line item level planning, rolling plans, new working version set up and user/data locking.

Planning is currently done in SAP Enterprise Resource Planning and excel, but this approach has several drawbacks and issues which make it very inefficient and painful to do planning. Some of the issues with SAP Enterprise Resource Planning system and excel based planning include:

- Extremely Time Consuming
  - To set up a new working version requires numerous transactions and copying data (actuals, previous forecast, and resources).
  - Issues related to foreign currencies and translations.
- Constant Validation at every step. Data has to be validated manually at each step.
- To be hired employee planning process is extremely manual and frustrating. There is very little information on employees to be hired, like no employee number, no information on department, cost center, benefits, etc. without these information it is very difficult to plan and requires lot of manual steps. Also, different countries have different rules for benefits and compensations which makes manual planning even more complex and less accurate.
- Must be run for single fiscal year at a time.
- Line item/activity/event planning is not a standard system feature.
  - Workarounds for tracking events and custom reports for displaying notes.
- Standard SAP does not support a rolling plan. SAP Enterprise Resource Planning System does not support rolling planning. SEM-BPS [3] supports development of rolling plan scenarios using actual data from SAP BW [9].

- Worldwide users lock each other out of transactions when creating new versions, copying actuals, or copying versions.

SEM Business Planning and Simulation

SEM Business Planning and Simulation solves the above mentioned planning pain points and also provides additional features, greater flexibility, and greater insight into business data. Below are some of the advantages of implementing Business Planning and Simulation.

- Comprehensive Simulation and scenario analysis.

- Easy to create new planning versions. Everything will be automated saving lots of time and eliminating manual errors.

- Automatic built-in validations.

- Quick Planning times, reduced from weeks to days.

- Simplified to be hired employee process and a uniform interface for all countries and Regions.

- Planning can be extended for multiple years.

- Decision support tools for operational and strategic resource optimization and cost management issues.

  o Reports generated using planned data provide systematic view of the expenses in the company, which help to make the decisions faster.
Since data access is restricted by planning access roles, there is no locking issue with users.

- Model relationships between Markets, competitors and Synopsys.
- Building queries to for generating reports.
- Easy Integration, Extraction, transformation and Loading of data from SAP Enterprise Resource Planning, which is the transactional system in Synopsys.
- Uses SAP BW [9] as the data warehouse for storing the data.

Scope of Project

Business Planning and financial Planning application will be used for financial planning and forecasting within Synopsys. The planning will be divided into International and domestic planning.

International planning will be divided into four regions: Japan, India, Europe, and Asia. Domestic Planning is divided into two regions: Chile, Armenia, and Canada; North American Region. Figure 1 shows the Synopsys World Wide Planning distribution.

The developed System will be used for planning in mainly two areas: Employee Planning and Expense Planning, which are further divided into categories as outlined below.

**Employee Planning**

1. TBH Planning: To-Be-Hired Planning (TBH), This is used for planning future hiring in the company for various departments. This helps in projecting the hiring for two years and gives the estimated financial projection for hiring in various areas like, salary, compensation, spot bonus, travel expenses, etc.
2. Workforce Planning: This is used to terminate employees and do the financial calculations based on the date of termination.

3. Current Employee Planning: This is used to do current employee planning in various area like salary, compensation, travel, spot bonus, Training expenses, Supply Expenses, H/W Expenses, Benefits, CIP, etc.

Expense Planning

This is used for Salary/Wages planning, Depreciation Planning, Contractor Expenses Planning, Travel Expense Planning, Meals and Entertainment Planning, etc.

Figure 2 shows different planning areas within Synopsys as described above.
Development Road Map

Development of planning applications will follow Software Development Life Cycle, beginning with feasibility analysis, risk analysis, Analysis of benefits v/s effort, communication analysis, requirement gathering, planning, designing and implementation. Since this application involves interaction between multiple systems, planning and designing will be done at different levels. The following is the summary of the systems involved and their purpose.

Fig. 2. Planning areas.
1. SAP ERP (Enterprise resource Planning) as source system to extract transactional data.

2. SAP Business Warehouse to hold business intelligence data.

3. BPS (Business Planning and Simulation) to develop the planning environment.

ABAP (Advance Business Application Programming Language) will be used as a primary programming language for developing application. ABAP [15] is a fourth generation language, with complete support for object oriented programming. Coding will be done at all the three levels of the application mentioned above. The following is the summary of the development effort in the three levels.

**Source System Development Activities**

1. Identifying data tables. SAP transactional system consists of thousands of tables to hold data. Extensive research and debugging is required to identify data tables.

2. Creating Datasource. Datasource is the logical structure created to represent the data to be transferred to Business warehouse system.

3. Creating extract structure. Extract structure is like a table view, with columns representing the fields of the data to be transferred to Business Warehouse system.

4. Writing extractor to extract the data from source transactional system into Business Warehouse system.

**Business Warehouse Development Activities**

1. Cubes Development: Cubes are multidimensional structures within SAP Business Warehouse, which are used to store data and to do multidimensional data analysis and reporting.
a. Developing Basic and Transactional Cubes (BW). These are 3D (three dimensional) structures used to hold transactional and planning data.

b. Creating Transfer Rules and Communication Rules (BW). Transfer rules are used to transform the data extracted from source system to business warehouse compatible format and, to map extract structure fields to corresponding fields in business warehouse. Communication rules are used to do data transformation within business warehouse system.

c. Creating Infosource, Infopackage (BW). Infosource consists of transfer structure, which is the structure of data in business warehouse; transfer rules are applied on this structure to transform data to desired format.

d. Developing Data Extractors from Transactional Systems (ABAP).

e. Scheduling Extraction (BW).

BPS System Development Activities


2. Create Planning Levels (BPS).

3. Create Planning Packages (BPS).

4. Develop Planning Functions (BPS, ABAP, FOX Formula).
   a. HR Version to Version copy.
   b. Delete Employees.
   c. Copy from HR.
   d. Salary Based calculations.
   e. Posting to Expense Area.
   f. Delete TBH.
g. TBH uploads.
h. Change Employee DOT.
i. Re-Calculate Workforce.
j. Actuals to Version Copy.
k. Quarter-to-Quarter Copy.
m. Depreciation Simulation upload.
n. Delete.
o. USD Translate Refresh.

5. Create parameter Groups for all planning functions (BPS).

   a. Employee Planning Layout.
   b. Workforce Planning Layout.
   c. TBH Planning Layout.
   d. Expense Planning Layout.

7. Develop utility program (ABAP) as wrappers/access points for application (ABAP).
   a. Version Creation Program.
   b. SKF Utility Program.
   c. Variable Change Utility Program.
   d. HR Utility Program.
   e. Delete Variables Program.
8. Developing Queries for reporting purpose.

9. The initial list of ABAP programs to be created for this application includes:
   b. Depreciation Upload Program.
   c. Depreciation Initialization Program.
   d. International Depreciation Function Group.
   e. International Depreciation Upload Program.
   f. International Depreciation Initialization Program.
   g. Function group to hold all general purposes functions.
   h. Program to calculate number of days.
   i. Program to convert fiscal period to fiscal quarters.
   j. Program to do employee planning.
   k. Program to get beginning period for current fiscal quarter.
   l. Program to extract current fiscal quarter from system.
   m. Program to extract data from transactional system into Business warehouse.
   n. Program to upload be hired information.
   o. Initialize to be hired information.
   p. Create/Update planning versions.
   q. Program to create all planning menus.
   r. Program to set all planning variables.
   s. Program to upload/download statistical key figures.
   t. Program to terminate an employee.
u. Program to delete variables and users.

v. Program to post data from one area to another area.

w. Program to copy data from one version to another in expense layout.

x. Super user version upload program.

y. Super user version to version copy program.

Technologies Used

Following technologies will be used during the course of project development.

- SAP Business Warehouse [10], [11]. SAP Business Warehouse will be used for designing and modeling multi-dimensional for storing all transactional data which is used for financial planning.

- ABAP: Advanced Business Application Programming Language [15], [16]. ABAP is a 4GL programming language provided by SAP for developing applications within SAP.

- SAP BPS (business planning and simulation tool) [8], [9]. BPS Business planning framework from SAP, which will be used to develop planning application.

- Fox-Formula [18] (a programming language used within BPS environment). Formula language will be used for manipulating the data within the BPS framework. This language provides features for data manipulation and easy data migration of between different areas.

- Bex Business Explorer [19] (front-end tool for creating queries to generate reports). Business explorer will be used for creating reports based on planned data, which will provide Company Executives with the financial information at various levels.
CHAPTER II

LITERATURE REVIEW

This chapter discusses various aspects of financial planning applications using published reference articles and books. It discusses SAP SEM-BPS [3] which is planning framework for developing financial planning applications and other technologies in the development of the application.

SEM – BPS [3] is a business planning framework provided by SAP. The area of operation stretches from simple data entry to complex scenarios with data extraction form transactional systems, employee planning, workforce planning, expense planning, to be hired employee planning, layoff planning, reporting on the planned data and analyzing it to obtain business knowledge from the data to get better insight into the financial health of the company. Figure 3 shows the general Business planning areas in any company [2].

As shown in the Figure 3, Business Planning spans various areas in a company. SAP BPS [3] tool can be used for developing planning applications in all areas of a business across all the industries. The scope of the project will be to implement financial planning within Synopsys, as explained in below sections.

SEM-BPS [3] is a planning tool that is used to develop planning applications within a company. It provides a platform for developing and configuring planning logic, but it does not hold any data within itself. It uses SAP Business Warehouse (SAP BW) [9] to get the data. Planning involves using the current transactional data to predict the
Fig. 3. Business planning area.


future data, which is helpful in decision making process. BPS uses the transactional data stored in business warehouse, manipulates the data using the planning functions and other logic used in a planning process and stores the data back in Business Warehouse. SAP business warehouse uses complex data models to store transactional and master data.

Planning is an integral part of any company’s strategies to achieve company’s goals.

Entrepreneurs and business managers are often so preoccupied with immediate issues that they lose sight of their ultimate objectives. That’s why a business review or preparation of a strategic plan is a virtual necessity. This may not be a recipe for success, but without it a business is much more likely to fail. [4]
The following is extracted from SAP Press [5], which emphasizes on the need for any organization to implement a comprehensive planning solution,

Business Planning and Simulation provides functionality to support integrated strategic and operational business planning on multidimensional data structures. These functions include: creation of dynamic and linear business models; modeling and simulation of various scenarios, scenario planning and evaluation of these scenarios taking account of the business risks; carrying out the resource allocation as part of business planning; cross functional enterprise planning and rolling forecasting, triggered by strategic KPI targets. [5]

Planning, budgeting and forecasting are the key business processes in any successful business process management and selecting a good technology framework to create these applications is of outmost importance. The following is extracted from an article by Craig Schiff [7] which emphasizes on the requirements for selecting a tool for creating financial planning applications,

There are many technology implications for these important business processes. For starters, because most companies will spend time in each area of planning, budgeting and forecasting, the technology needs to support all three, ideally with a consistent interface and set of processes. For instance, if someone is familiar with how to budget in the system, they should be able to easily move on to forecasting when ready. [7]

SAP’s SEM-BPS framework supports planning, budgeting and forecasting in a seamless manner. A single application can be developed and configured to be used for planning, budgeting and forecasting, thus eliminating need for separate applications/tools for each of the business process. Extremely user friendly UIs and web reports can be developed with SEM-BPS [3], which makes it easy to use and perform data reporting and analysis. Web reports with drilldown to multidimensional data can be easily developed with SAP BW [9], which can be used by executives for monitoring the business process, expenses, etc.
All the strategic decisions and business process improvements are intended for company’s growth and to maximize shareholders and investors values. To deliver sustained superior returns to shareholders and inverters is one of the key issues faced by CEOs today [7]. Any decision making process should provide transparency to analyze the impact of the decision. Hence a decision support system should allow executives to make operational decisions along with strategic decisions. SAP Business Planning and Simulation [3] application will provide executives with insight into data which will enable them to make operational as well as strategic decisions.

Planning in an organization without any planning infrastructure takes place in many steps with potential for lot of errors. As a first step different departments in an organization prepare their planning premise, planning standards and processes. As a second step, plans from different regional groups are created and reviewed in regional review meetings. As a third step divisional plans are created and regional plans are reviewed. As a final step executive board members review all the planning documents, reconcile the numbers and accordingly make operational and strategic decisions. The following white paper from SAP press discusses the planning process and how BPS [3] can be used to address all planning issues, to develop a robust and flexible planning application and how planning can be viewed as self-renewing and learning process concerning future of the organization [8].

Planning applications need to be structured in a hierarchical manner as the scope of the application spans an entire organization. Planning is done based on various area within an organization like HR planning, Expense Planning etc. Each area needs to have access to data that is needed by various planning levels and functions within an area.
This data restriction between different area, planning levels and planning functions can be provided if the application framework supports hierarchical structure. SAP BPS [3] structures application into various planning area, with different planning levels, with each level consisting one or many planning functions [9].

SAP Business Intelligence, which is next version of SAP business warehouse [9], will provide support for service oriented architecture (SOA) [10], which will enable to build re-usable, self contained business functions, which can be used in any application within SAP framework.

The migration of SAP Business Planning and Simulation to SAP business intelligence integrated planning will allow developing functions based on business process thus providing loose coupling between components. These components can be combined with other components to build a new application, thus saving lot of development time.

Any process cannot exists in isolation, it needs an input data, process that data according to specific business logic and store the results in some structure which is optimized for reporting. OLTP (online transaction processing) like oracle DB (Database) systems are optimized for write operations, they cannot support complex analysis scenarios. OLAP (online analytical processing) systems are optimized for complex multidimensional data analysis. Planning process can generate the planned data, but it itself cannot store or run analysis on the data. To store the source data, planned data and to run complex multidimensional analysis, we need OLAP system. SAP BW [9] is a Business Intelligence Platform which supports data extraction from multiple transaction systems, modeling complex multidimensional structures, and creating reports to report on
the data. The following extract from white paper by Jude Lobo [11], quotes on the ability of SAP business warehouse [9] to do multi-dimensional analysis on huge volumes of data.

The SAP Business Information Warehouse enables Online Analytical Processing (OLAP) to format the information of large amounts of operative and historical data. OLAP technology enables multi-dimensional analyses according to various business perspectives. The preconfigured Business Information Warehouse Server for core areas and processes ensures information views within the entire enterprise.

SAP BW provides extensive support for data Extraction Transformation and Loading (ETL). It also provides various multidimensional structures which support real time data loading which is one the most important requirement of business planning applications. SAP BW provides framework to create complex reports to analyze the data generated by a planning process, which is the final goal of a planning process. Planning is used to generate business information, which can be viewed using reports. Reports help the executives to make a well educated decision aligning with company’s goals. *SAP BW, A Step-by-Step Guide* by Biao Fu and Henry Fu [12] emphasis on the importance of Business Warehouse and provides a detailed explanation on how to implement an SAP Business Warehouse. This book describes in detail a special technique called SAP star schema which makes it easy to retrieve large volume of data quickly for analysis.

SAP Business Warehouse also provides an easy way to develop and expose web services [13], which can be consumed by any application. It also supports a web development framework, to develop web based SAP applications. Web enabled planning applications can be developed with BW and BPS [3], which eliminates need to install SAP frontend client for end users. Any SAP Business planning application can be easily
converted to web based planning, by using all existing components and only developing data entry layouts as web pages.

BPS [3] and BW [9] provide tools and framework for developing planning applications, but planning logic and data processing needs to be coded in some programming language. Planning applications by very nature of planning are extremely complex, which need 4GL language for writing the planning application. SAP ABAP [15] is a 4GL language, which can handle huge volumes of data, provides data structures optimized for database access, like internal tables, which can be used to model a database table within a code. It also provides support for pointers which are necessary when building scalable and flexible business applications. ABAP [15] is one of the first languages to introduce the concept of logical databases within programs which gives high level of abstraction from actual database. One of the great strength is that is posses a great variety of data types and objects which span the spectrum from basic data types to very complex and dynamic objects. The following is an overview of the data types in Sap ABAP

- Types: Object
  - Data Types: Data Objects
    - Elementary Types
      - Fixed Length
        - C: Text Filed
        - N: Numeric Field
        - D: Date Field
        - T: Time Field
• X: Hexadecimal
• P: Packed Number
• I: Integer
• F: Floating Point Number

• Variable Length
  • String
  • XString

• Complex Data Types
  • Structure Type
  • Table Type

• Reference Types
  • Data references
  • Object references
    • Class reference
    • Interface reference

• Object Types
  • Class
  • Interface

Writing SAP ABAP (Advance Business Application Programming) Programs requires in-depth knowledge of SAP ABAP framework, screen developments, report developments, internal tables, batch processing etc.

*Writing SAP ABAP/4 Programs* by Theodore Hoffman [15] discusses ABAP programming in detail on how to use it to develop SAP business applications.
Although ABAP (Advance Business Application Programming) is a procedural language, complete object programming can be done using ABAP objects, which is an object oriented version of ABAP (Advance Business Application Programming) programming language.

ABAP Objects – an Introduction to Programming SAP Applications by Horst Keller and Sascha Kruger [16] provides details on how to do object oriented programming in ABAP.

BPS framework provides a set of API [17] to access data and manipulate it within the framework. Since data access within planning application depends on the level of the access to the planning function within the framework, the APIs allow data access to the ABAP program based on its position within the application structure.
CHAPTER III

ARCHITECTURE OF SEM–BPS

SEM-BPS is a planning tool that is used to develop planning applications within company. It provides a platform for developing and configuring planning logic, but it does not hold any data within itself. It uses SAP Business Warehouse (SA PBW) to get the data. Planning involves using the current transactional data to predict the future data, which is helpful in decision-making process. BPS uses the transactional data stored in business warehouse, manipulates the data using the planning functions and other logic used in planning process and stores the data back in Business Warehouse. SAP business warehouse uses complex data models to store transactional and master data. Figure 4 shows high-level architecture of BPS.

As shown in Figure 4, BPS is made up of the following layers:

1. Data Storage Layer
2. Buffer
3. Planning Model
4. End User Interface
5. Planning Process

Data Storage layer is a Business Warehouse Layer, which is used to store transactional and master data used during planning process and also to store planned data.
It uses complex data models to store data called infocube, which is a multi-dimensional structure within SAP Business warehouse. Infocube is one of the very important components within the planning framework.

Buffer is used to store data temporarily during the planning process to improve the speed and performance of the planning application. The data being manipulated is stored here during planning and once done, it is written to Infocube. This is completely automated and requires no intervention from application developer.
Planning Model is used to model and develop the planning application. It is comprised of following components used in planning application:

1. Planning area
2. Planning level
3. Planning package
4. Planning function
5. Planning sequence

End User Interface is used to develop web applications for generating reports which are run on the planned data. Planned data is stored in Infocubes, which can be accessed by only developers and not by end users, also data in Infocubes is stored in complex multidimensional structure, which is difficult to access and makes sense out of the data. Business Explorer from SAP is used to develop reports on Infocubes, which is used to extract information from data, used for decision making. Figure 5 shows the interaction between three critical components of BPS.

Fig. 5. Interaction between three critical components of BPS.
Planning modeler uses transactional data from Warehouse, generates planned data and stores it back in Business Warehouse, End interface is used to run reports on planned data to get information pertaining to decision-making process.

**SAP Business Information Warehouse**

Reporting, analysis and interpretation of current and historical data within a company is of utmost importance for maintaining competitive edge within a market, for optimizing processes and for reacting quickly and in timely manner to changing business needs and be in line with market. SAP business information warehouse provides data warehousing for storing current and historical data, business intelligence platform with a suite of business intelligence tools for extracting information and knowledge out of data which is needed for making important business decisions. SAP Business Information warehouse can be easily integrated with source transaction systems to extract, transform, and load data into warehouse, which can be used to make timely and educated decisions to identify activities which are target oriented. Figure 6 shows the structure of SAP BW.

As shown in the Figure 6, SAP BW is made up of three components:

1. Data Warehousing
2. BI Platform
3. BI Suite

Data Warehousing is used to extract, transform, consolidate, and cleanup the data from source systems. Data warehousing process includes data extraction, data modeling, and administration of data warehouse. Data modeling involves complex process of creating objects like Infocubes, ODS (Operational data stores), Infoobjects,
BI Platform is a business intelligence platform which provides various analytical and business intelligence tools, technologies, and functions. BI platform includes, Business Planning and Simulation, OLAP processor, Meta data repository, various analytical processes like Data Mining.

BI Suite provides powerful reporting and analysis tools for strategic analysis, operational reporting, and decision support knowledge. It includes a set of tools like query designer, web application designer, analyzer for creating queries and reporting applications which are used by end users. It provides features like broadcasting reports by
email to a pre-defined set of people in the form pre-defined report or links to an active report. This is one of the important end user tools used extract and view information from various perspective. Figure 7 shows sub areas and functions integrated within BW.

Fig. 7. Sub areas and functions integrated within BW.

Figure 7 shows how various components are integrated within SAP business Information warehouse. Administrator Workbench which is part of data warehouse is used for Modeling, Monitoring, scheduling and Administration. Data warehouse is made up of objects like Operational data Store (ODS), Infocubes, Master Data which hold the data in single/multidimensional view. This is the central part of Business information warehouse which is used by BI platform and Business explorer suite. BI platform provides OLAP functions for data analysis and Business Explorer suite provides tools for reporting and analysis.

Infocube and Infoobjects Within SAP Business Warehouse

Infocube is a multidimensional data model within BW. OLAP processor is used to perform multidimensional analysis of data within infocube to extract knowledge and information from data.

Proper designing of infocube is one the key aspects for developing business intelligence related applications. Most of the transactional systems store data in a relational data model which is highly normalized. Normalization is the process to remove repeated data by moving the data to connected auxiliary tables thereby reducing the size of original table. This approach works fine for adding, deleting, or updating records, but is not optimal for analysis type queries.

Multidimensional data model are needed for creation of enterprise data warehouse or OLAP applications. In other words for analytical applications OLTP system’s normalized design cannot be used as it suffers from performance issues for analysis type of queries. Star Schema design is used to create most of enterprise data
warehouses. Figure 8 shows the classic star schema design used in enterprise data warehouses.

**Fig. 8. Classic star schema design used in enterprise data warehouses.**

Star schema design classifies data into two categories of facts (amount, sales quantity, number of employees, and dimension characteristic, attributes that define the facts (travel, salary, and bonus):

- Travel is a characteristic that identifies the amount spend in a category, for example, travel = $1000.
- Travel is a dimension attribute and $1000 is a fact or a key figure.

As shown in the Figure 8, star schema consists on central fact table which is connected to dimension tables. Fact table contains key figures (quantity, amount, etc.) and dimension id, which are foreign key for dimension tables.
Figure 9 illustrates classic start schema design. It consists of fact table (Sales items) which contains two key figures quantity sold, amount sold and foreign keys (product id, customer id, store id, etc.) connecting to corresponding dimension tables. Dimension tables hold the actual characteristics of the data. For example, Products dimension holds product description, color, type, etc. OLAP processor can be used in this star schema to do multidimensional analysis to answer such questions as:

- Which products were sold when and how much quantity?
- Which products were sold to which customers and when?
- Which customers have bought a particular product and how much?
- Who is the most valued customer?
Answering questions like above helps an organization to get an insight into the company performance, identify key customers, identify busy period in a year, identify locations with most products sold, etc.

This information can be used to make important business decisions in a timely manner.

SAP BW Extended Star Schema

SAP BW has extended classic star schema to eliminate both technical and reporting problems related to classic star schema. SAP BW’s extended start schema data model is called Infocube. Infocube is made up of infoobjects. Infoobjects are smallest entity holding data in SAP business warehouse. Understanding infoobjects is essential to understanding SAP business warehouse.

Infoobjects

Infoobjects are smallest information module in SAP Business warehouse. They are divided into characteristics (e.g., customer), key figures (e.g., revenue), Units (e.g., currency like dollar), Time Characteristics (e.g., hour, month, day, etc.), and technical Characteristics (e.g., request number). Infoobjects are used through the system to build different data models like Operational Data stores, infocubes which store data. They are also used to store master data. Figure 10 shows an infoobject within SAP Business Warehouse System.

Infoobjects are the building blocks within SAP Business warehouse system. Building any data model requires infoobjects, like infocubes, Operational Data Stores, Transfer Rules, Update rules, etc all are made up of infoobjects. Every individual piece
of information within a company can be modeled using an infoobject. For example, an Employee will be an infoobject. As shown in the Figure 10, infoobject has a type and length (e.g., employee id needs to be eight characters within Synopsys).

Infoobject has various properties associated with them, as shown by tabs in Figure 10. Business Explorer defines the properties that are used when display a report from an infocube. This defines how infoobject information will be displayed.

An infoobject can have one or more attributes. For example, an employee within a company by itself has no meaning. Employee in company is identifies by his/her country, area, employee group, employee subgroup etc. Attributes themselves are again infoobjects. Figure 11 shows attributes of infoobject for an employee.

All the data in an infoobject is stored in number of tables depending upon the type of data. There is a table for time dependent attributes, time independent attributes.
Also, there are SID tables for time dependent and time independent attributes. SIDs are internally system generated values for each characteristic value. SIDs are used by OLAP process while running analysis queries. Figure 12 shows various table generated for storing employee related information.

Infocubes

Infocubes are one of the most important structures in SAP Business warehouse for building any analysis application. They are built on the extended star schema developed by SAP. Infocube is built using number of relational tables arranged in multidimensional fashion meaning, there is a central fact table surrounded by dimension tables, which contains SID as primary keys. SIDs link the dimensions to corresponding master data tables which were discussed in previous section. Dimension contains all logical related attributes group together in a table. Figure 13 shows the extended star schema.
As shown in the Figure 13, an infocube consists of a central fact table which holds key figures like amount, quantity and contains dimension IDs which are foreign keys if dimension tables. Dimension tables contain SIDs which are again foreign keys of SID tables, which point to master data. For example, in Figure 13:

- Fact table contains DIM_ID_COST_ELEMENT dimension ID, which points to COST_CTR_DIM dimension table.

- Dimension table COST_CTR_DIM contains SID, for example SID_COST_CENTER, which points to a record in SID table.

- SID table has SIDs which point to master data.
Fig. 13. Extended star schema in SAP BW infocube.

- Figure 14 shows relationship between various tables in SAP-BW [9] extended star schema.

Figure 15 shows an infocube with all its dimensions with SAP BW. Figure 16 shows an infocube with all the infoobjects used. Every infoobject used is assigned to a dimension. The dimensions for the below cube are shown in Figure 17. An infocube can have maximum 16 dimensions, with three pre-defined dimensions by SAP for time, unit and package.
Populating Data in Infocube

Data from source transaction system is extracted into infocubes which is used for analysis by OLAP processor. Data extraction from source transactional systems is usually scheduled daily. The following Structures are involved in populating data in an infocube:

1. Extract Structure
2. Transfer Structure
3. Transfer Rules
4. Communication Structure
5. Update Rules

Fig. 14. Infocube data organization.
Fig. 15. Infocube design in SAP BW.
Steps in Extraction, Transformation, and Loading of data from source system to infocube:

1. Create an extraction function module in source system and an extract structure. Extraction function module (i.e., extractor pulls data from various sources in transactional system like tables and populates the extract structure).

2. Create an infosource in BW, which has a data source assigned to it, which is the one created in step 1.
3. Data from extract structure is transferred to transfer structure. From transfer structure, transfer rules are used to manipulate the data if necessary and the data is populated in communication structure.

4. Using update rules on communication structure, data is loaded into infocube. Infosource contains transfer structure, communication structure and infopackages. Infopackage contains setting information on how the data is to be loaded, like scheduling.
information, delta or full update, data targets to be updated etc. The Figure 18 shows the process of loading the data into an infocube.

Fig. 18. Process of loading data into infocube.
BPS in SAP Business Warehouse

Planning is usually done along organizational structures. Defining planning process involves defining planning process according to scenarios. In planning process work packages must be defined for different users as per their responsibilities and planning strategies must be set up in order to consider the course of events and the interdependencies of different steps.

BW-BPS offers different interfaces for planning application developers and users. Planning framework is used by developers while planning folders are interface for application users. Figure 19 shows the structure of planning applications within BW-BPS.

Fig. 19. Structure of BW-BPS application.
Planning area is a database for planning model (Figure 20). All organizational structures and planning tasks related to planning process can be setup in planning area.

Fig. 20. Planning area within BPS framework.

Each planning area has one or more infocubes assigned to it. The planning area is consists of:

- Attributes
- Data Slices
- Variables
- Master Data
- Characteristic Relationship
Figure 21 shows an example of planning area within BW-BPS. A planning area is made up of one or more planning levels, which are sub tasks under a planning area. Variables in planning area are used to set up planning environment, which can be constants or can be set up during the planning. Master data is the Master data associated with infoobjects contained in infocube assigned to Planning area.

For example, company code master data within Expense Infocube. Characteristic relationship is used to specify relationship between attributes, like each company code has a currency associated with it, hence specifying characteristic relationship between these two entities, helps to get the correct currency for a company code (i.e., forces correct currency, reducing manual errors).
Planning Levels within BW-BPS Framework

Figure 22 shows planning levels with BW-BPS framework. Planning levels determines the granularity at which the data is planned. They are also used to define hierarchical orders of planning model (e.g., top down or bottom up). Planning functions and planning layout depend on exactly one level. Planning level has a subset of characteristics from planning area. Selection of characteristic values in planning level is used when the same selection applies to several planning packages (e.g., fiscal year 2009 is to be planned by all planners). Figure 23 shows the Planning level within SAP BPS.
Fig. 23. Planning level in BPS.

As shown in Figure 23, planning level contains subset of characteristics from planning area. It contains information necessary for planning a subsection of planning process.

Planning package within BPS Framework

Planning package is a subset of planning level (Figure 24). Planning packages are always assigned to one planning level. One planning level can contain many planning packages.
Fig. 24. Planning package within BPS framework.

All planning functions have to be within a planning package, if no planning package is created, then an ad-hoc package is created automatically by the system.

Planning Functions in BPS Framework

Planning functions in BPS contain the actual planning logic for the data determined by its position in framework hierarchy (planning area, level, and package). It is used to generate or manipulate the planning data. Planning functions can be executed manually during the planning process (e.g., copy from previous version, salary based calculations etc, or they can be part of save, so when the data is saved, functions is executed). For example, currency conversion can be put as a part of save, so when data is saved, corresponding currency conversion is done.
Planning function has a parameter group which contains values for parameters selected in planning function. For example, Figure 25 shows the planning function, ‘Change Employee DOT’ which has field to be changed as ‘valid to’ and fields for conditions on which to change values as ‘cc, employee and fiscal year,’ the values for this condition parameters are provided by parameter group. Figure 26 shows the parameter group for planning function ‘Change Employee DOT’. Figure 27 shows the general BPS application organization Structure.

Fig. 25. Planning function.
Fig. 26. Parameter group.

Fig. 27. BPS application organization structure.
CHAPTER IV

DESIGN OF APPLICATION

High Level Design

Planning involves extracting data from operational system (day-to-day activity data), storing it in business warehouse and use the data in business warehouse to plan and store the planned data back in business warehouse for reporting and analysis on planned information. Planning and Forecasting application is structured in three layers as shown in Figure 28. The three layers are:

1. BPS layer
2. Business Warehouse layer
3. R/3 Operation System layer

BPS layer contains all the planning framework and logic for:

1. Employee Planning
2. To-Be Hired Employee Planning
3. Workforce Planning
4. Expense Planning
5. Depreciation Planning

Business Warehouse Layer acts as data storage layer for planning application. All the planned data is stored in business warehouse structures like cube and ODS. It also stores the operation data on which planning is done. It acts as central repository for both
actual and planned data. Business warehouse layer contains multidimensional structures to hold with logic to extract data from operational systems. It is also used for analytical reporting on the planned data. The functions of the business warehouse layer are:

1. Data storage for planned data
2. Data storage for actual data
3. Extraction logic
4. Reporting and analysis
Figure 29 shows the high-level use case diagram for the application. Planner is an actor, who does the following tasks as part of planning process, for his/her area or business units, like finance, HR, Facilities, etc.

Fig. 29. High-level case diagram.
1. Create Version: Each planning cycle is done in a planning version, hence prior to each planning cycle a planning version is created for all planners to work with.

2. Employee planning.

3. To-Be Hired planning.

4. Workforce planning.

5. Expense planning.

6. Depreciation planning.

   The following sections explain each of the planning areas in detail with UML case and sequence diagrams.

**Employee Planning**

   Figure 30 and Figure 31 show a case diagram and a sequence diagram, respectively, for Employee Planning.

   In Employee Planning, planner (Actor) first needs to set some variables before any planning action is performed. Setting up variables determines the parameters for planning activity like which data is to be copied, which business unit data is to be copied, which planning area is to be used, and which planning version is to be used, etc.

   Once planning variables are set and various planning action can be performed depending upon the planning requirements. The following actions can be performed by an actor during employee planning:

   1. Version to version copy
   2. Delete
   3. Copy from HR actuals
   4. Benefits calculations
Fig. 30. Employee planning use case diagram.

5. Posting to expense layout

6. View data by year

7. View data by cost center
Fig. 31. Sequence diagram for employee planning.

For current employee planning if the information for planning is to be used from previous planning versions, then version to version copy action is performed.
Planners can delete the information if necessary from the planning layouts using delete function. HR actual data can be copied into planning version for planning purpose. Once the data to be planned on is in the system then benefits calculation action can be performed on that data to calculate various entities related to an employee. Planner also can see the data based on fiscal year for planning and cost centers to see different view of the same data.

**To-Be Hired Planning**

To-Be Hired planning is the planning for employees which various business units are planning to hire in fiscal quarter. This planning gives executives and estimate of planning employee expenses for each business unit within company. Figure 32 shows use case diagram for To-Be Hired planning.

Planner (Actor) doing To-Be Hired planning first needs to set variables to identify the version for TBH planning. Once variable are set then text file with to be hired employee information is uploaded into the planning system. If employees are to be deleted for some reason like incorrect calculations or wrong file upload then the file containing employees to be deleted is uploaded into the planning system. Then planner performs benefits calculations for various benefits associated with an employee which are determined by his/her grade, country, position etc. Then the planned data is posed to expense area for expense planning.

**Workforce Planning**

Workforce planning is used to terminate the employees from an organization within a company. Planner sets variables to identify planning version and employees to be terminated, date of termination, and then based on the employees and date of
Fig. 32. Use case diagram for to-be hired planning.

termination, benefits are re-calculated for future time period, which show the employee related expenses for the terminated employees (Figure 33).

Expense Planning

Expense planning is used to project future expenses with a company for a specific period of time in future, determined by planning logic. Figures 34 and 35 show UML case diagram for expense planning. Values calculated from all planning area like
employee planning, TBH planning, workforce planning are rolled up into expense planning for final expense projection.

Expense planning data come from various sources such as:

1. From operational systems
2. From employee planning
3. From depreciation
4. From previous planned versions

As shown in Figure 34, sequence diagram, planner needs to set variables to set the version, quarters, year and other planning parameters. Once all required variables are set, then planner can perform the following actions:
Fig. 34. Use case diagram for expense planning.

1. Copy expense actuals data
   a. This data is extracted daily as batch job from operation system and stored in BW, which is then pulled into planning framework when required.

2. Quarter to quarter copy
   a. This is used to copy data from one quarter into other quarter (e.g., to copy data from 2008-Q2 into 2008-Q4 and used that data as basis for planning).
Fig. 35. Sequence diagram for expense planning.

3. Version to version copy
   
a. Used one of previous versions data for expense planning.
4. Depreciation simulation
   
   a. Depreciation is used to plan the expenses for company’s depreciable expenses. This data is extracted into business warehouse everyday and then pulled into planning framework when required.
CHAPTER V

APPLICATION INTERNALS AND ARCHITECTURE

Business Planning in Synopsys within BPS is divided into five planning areas which cover Employee Planning and Expense Planning. Following is the list of the Planning as created:

1. Cost Center Actuals Planning Area
2. Cost Center/resource Planning Multi-Area
3. Employee Master Data
4. Expense Planning Area
5. HR Planning Area

Figure 36 shows the planning areas created for this project. The central idea behind any planning application is to get the transactional data from transaction system into the planning system and modify the data as per the application logic, so that the data provides insight into future, based on type of planning. For example, expense planning provides figures for expenses for next two years, sales planning provide sales information for next two years, etc.

Within BPS, each area is assigned an infocube which the area can access. All characteristics and Key figures in the infocube can be accessed within from the area which it is assigned to. The following section gives an overview of each planning
Fig. 36. BPS planning areas within Synopsys.

mentioned previously and subsequent sections will dwell in depth on the actual planning logic within the application.

Planning Areas Overview

Cost Center Actuals Planning Area

Cost Center Actuals Planning Area (ZBPBCC02) is used to hold Expense Actuals for the company. Infocube ZBPSAEXPC (Expense Actuals Infocube) is assigned to this area. This infocube is populated with the latest expense actuals data from the transaction system by running nightly data extraction. Figure 37 gives overview of Cost Center Actuals Planning Area.

Fig. 37. Cost center actuals planning area.
Infocube under attributes tab shows the infocube assigned to this area. As this area is just for holding actuals data, there are no variables created in this area.

**Cost Center/Resource Planning Area**

Cost Center/Resource Planning Area (ZBPMCC01) is a multi-area which is made up of two or more areas.

Within a BPS application, data from one area cannot move into another area (i.e., data from one area cannot be copied into other area). But planning applications frequently need this data migration between different planning areas, for example Expense actuals data from expense actuals planning area needs to be copied to expense planning area, which contains all the functions to modify the data which will reflect planned data. To achieve this data migration between two areas, a multi-area is created which facilitates the data transfer between two areas. Figure 38 shows Cost Center/Resource Planning Area (ZBPMCC01) multi-area within BPS.

![Fig. 38. Cost center/resource planning multi-area.](image-url)
As shown in the Figure 38, this multi-area is made up of four areas. The drop down in Figure 38 shows various planning levels within a planning area.

**Employee Master Data Planning Area**

Employee Master Data Planning Area holds transaction data (actuals) for employee. Infocube ZHREXP001 is assigned to this area. Data from transactional system are loaded by nightly data extracts. Figure 39 shows Employee Master Data planning area and infocube assigned to it.

![Fig. 39. Employee master data planning area.](image)

**Expense Planning Area**

Expense Planning Area contains planning levels and functions related to expense planning. Transactional Infocube ZCOEXPPL1 (Expense Transactional Cube) is assigned to this area. Transactional cubes are not populated by daily extracts; they are populated by planners, when they save the plan data. This area contains variables which are used by various planning functions within this area. Figure 40 shows Expense Planning Area and some of the variables in this area. Detailed discussion of levels and functions within this area will be covered in subsequent sections.
HR Plan/Forecast Data Planning Area

HR Plan/Forecast Data Planning Area is area for doing employee planning. Current employee planning, To-Be-Hired employee planning and Workforce planning are done in this area. Transactional cube ZBPSHRPL1 (Workforce Planning) is assigned to this area. Data in this cube is populated by planners.

This area contains levels and functions used in current employee planning, To-Be-Hired employee planning and Workforce planning.

Figure 41 shows the HR Plan/Forecast Planning area with the cube assigned to this area.

Planning Application Versions and Access Restrictions

During every planning cycle, a plan version is created which is used by all planners to plan. All planners can plan simultaneously in the same version. Planners can only plan and access/modify data based on the access/authorization granted to them.
Planning can be restricted by company code, cost center, business area; regions etc, Hence planners have access only to their data thus maintaining the integrity of the data. Planning restrictions are maintained by variables in planning areas which are propagated based on the variables used in planning levels.

As shown in the Figure 42 planner “ANNIB” is restricted to company codes “CA02, CL01, ELM1, US01, US31 and US40.” She can plan and access data only for these cost centers in the level where this company code variable is propagated. As shown in figure 44, planning level HR Copy International uses variable ZBPSSN01 for company code, which is shown in Figure 42.

All functions within this planning area, for a planner can only access data based on values assigned to that planner in planning area. For example, planning functions executed by planner “ANNIB” can only be run on data belonging to country codes shown in Figure 43.
Fig. 42. Access restriction based on company code.

Fig. 43. Planning level with access restriction.
Planning Folders and Layouts

Planning with Synopsys is done in following in following areas:

1. Employee Planning
   a. TBH Planning (To Be Hired)
   b. Workforce Planning (Employee termination)
   c. Current Employee Planning

2. Expense Planning
   a. Depreciation Simulation
   b. Expense Planning

Planning Folders and planning layouts are user interface which the planners see when planning. Planning folder is a logical grouping of common planning folders functions and layouts. For example, as shown in the Figure 44, planning folder

![Planning Folders](image)

Fig. 44. Domestic planning folders.
“Domestic Planning,” contains folder “North American Region,” which contains “Employee Planning” folder. Layouts are actual planning area for planners, which contain planning functions and layouts to display and add data. As shown in Figure 44, Employee Planning folder contains, following layouts:

1. Domestic OBJ TBH Planning
2. Domestic OBJ workforce Planning
3. Domestic OBJ current Employee Planning

Figure 45 shows Expense Planning Layout with different functions available within the layout.

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Fig. 45. Planning folders and layout.
Variables Set Utility Program

To set the variables, a variables set utility program is used, which is developed in ABAP programming language (Z_BPS_VAR_UPLOAD_ALL_USERS). To execute any function, first a variant needs to be selected. Variants are set of predefined inputs to the program. They are used to minimise the user interaction, so that users can only enter the minimum required inputs. In the Figure 46, selecting “EMP DELETE” variant sets the variable like planning area, target version variable and target value type variable. Executing this program, sets variable “ZBPSWW06 to X04” and “ZBPSWW15 to 60.” Variables set using this program are used by function within planning layouts.

![Fig. 46. Variable set program variant.](image_url)
Layouts and Planning Functions Created for Planning Within Synopsys

TBH Layout

This is the layout where To Be Hired employee planning is done. Figure 47 shows the TBH layout with all planning functions with layout.

![TBH Planning layout](image)

Fig. 47. TBH planning layout.
As shown in Figure 47 TBH layout has information on employees to be hired, like cost centers, valid from data, valid to date, annual salary and other figures and benefits. All the key figures (amounts) like pro-rated salary, commissions, benefits etc are calculated using “Salary Based Calculations” Function shown in Figure 47.

Following functions are available in TBH layout:

1. **Delete TBH.** This function deletes all the TBH’s in the layout (i.e. it empties the layout). To delete the TBHs correctly, variables need to be set to identify the records in Infocube to be deleted. Figure 48 shows the variables needed and function details like planning area and planning level to which it belongs.

![Fig. 48. Delete TBH planning function.](image)
To set the variables, a variables set utility program is used, which is developed in ABAP programming language. To execute this program, first a variant needs to be selected. Variants are set of predefined inputs to the program. They are used to minimise the user interaction, so that users can only enter the minimum required inputs. In the Figure 49, selecting “EMP DELETE” variant sets the variable like planning area, target version variable and target value type variable. Executing this program, sets variable “ZBPSWW06 to X04” and “ZBPSWW15 to 60.”

Fig. 49. Variable set program.
Figure 50 shows the variables set after the program execution. These two variables are used to delete TBH function to identify the correct records for deletion along with access restrictions provided by variables at area level, like access to company codes and cost centers.

<table>
<thead>
<tr>
<th>Planning Area</th>
<th>Variable</th>
<th>User Name</th>
<th>Characteristic</th>
<th>Lower Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZEPTH01</td>
<td>ZBPSWW05</td>
<td>MSHIRARA</td>
<td>VERSION</td>
<td>X04</td>
</tr>
<tr>
<td>ZEPTH01</td>
<td>ZBPSWW15</td>
<td>MSHIRARA</td>
<td>0TYPE</td>
<td>050</td>
</tr>
</tbody>
</table>

Fig. 50. Variables set after set variables program execution.

2. **TBH Uploads.** This function is used to upload TBHSs into the layout. Planners first prepare a list of TBH with details like start date, salary etc and then upload it into the TBH planning layout. The format of the upload file is specified by the upload program. Figure 51 shows the TBH upload function details, like planning area, planning level and upload program used.

As shown in the Figure 51 TBH uploads function uses two ABAP functions:

1. `Z_BW_BPS_TBH_UPLOAD_ROUTINE`

2. `Z_BW_BPS_TBH_UPLD_ROUTINE_INIT`

The exit function modules enable the use of planning functions that cannot be used with the planning functions delivered. The function modules are handled just as the planning functions delivered by SAP, that is, they are called up or appear on the end user’s interface in the same way.
A function module to initialize the planning function. This function module is optional. It is only required if new transaction data records are to be generated in the planning function that are different, in terms of the combinations of values, to characteristics in the previous transaction data that are not to be changed. The keys for these new transaction data records are delivered by the function module in the table ETO_CHAS. The keys are supplemented by the keys of the transaction data that already exist. The data objects for which the planning function is called up are formed from these keys. They also influence how often and with which combinations of transaction data the second function module is called up.

A function module that is called up several times and that changes transaction data records. This function module receives a package of transaction data records in each case. These differ only in their characteristics to be changed. They have the same values as far as all other characteristics are concerned. The
transaction data is in table XTH_DATA. Only the existing records are transferred. If key combinations were returned by the initialization function module, and no transaction data exists for these, then table XTH_DATA is empty. The key combination is in the table ITO_CHASEL. Figure 52 shows the uploaded data in TBH layout.

Fig. 52. Uploaded TBHs in TBH layout.

3. Salary Based Calculations Function. This is a ABAP program developed to perform various calculations based on salary. Following fields are calculated, based on various percentages maintained in the system as well as based on various formulas used within the company. Following informaion is computed based on initial salary upload using the function described previously:

1. Pro-rated salary
2. Benefits
3. CIP (Corporate incentive Plan)
4. Commission
5. Merit Increase
6. Spot Bonus
7. Travel
8. Training
9. Supplies
10. Hardware Cost

Figure 53 shows the details like planning area, planning level, planning package and ABAP function used in salary based calculations function with TBH layout.

Fig. 53. Salary based calculations.
4. Posting HR to CO Function Within TBH Layout. This function is used to transfer all the records in TBH layout to Expense Planning layout. Expense Layout maintains data based on cost elements and the currency for the layout is controlling currency (i.e., USD. TBH layout does not have cost element related to records and currency can be any currency depending on the country of planning). Hence during the transfer first all the records are mapped to the corresponding cost element in for expense layout and currency translation is done. Figure 54 shows the details of this function.

Fig. 54. Posting HR to CO function in TBH layout.

To achieve the dual purpose of data copy, mapping and currency translation, a planning sequence is created. Planning sequence is a special type of function within BPS
which contains two or more functions to be executed in a sequence. As shown in Figure 55 Posting HR to CO Function contains two functions, “Transfer HR calculations and Currency Translation” executed in the the sequence. Transfer HR Calculations Function copies data from HR area Infocube to Expense area Infocube, mapping each record to corresponding cost element. This function is written in formula language called “FOX.” Figure 55 shows the function details.

Currency translation is a standard function provided by SAP. it requires inputs like version number, source currency, target currenct and exchange rate to used to identify which currencies are to be translated. Exchanges rates are maintained with SAP system based on company policies. Figure 56 shows the currency translation function.

As shown in the Figure 56, this function translates, source currency (i.e., local currency like India rupee) into controlling currency (USD), based on exchange rate 001P, maintained in the system. Different rate types are maintained in compnay for different purpose like planning, forecasting etc.

**Current Employee Planning Layout**

This layout is used to do current employee planning. Figure 57 shows the current employee planning layout with the planning functions for this layout.

Data in this layout is pulled based on the function executed by the planner. Since To Be Hired employees are company employees, on saving the data the data is written to HR infocube, which is used by this layout, Hence the planners who have done TBH planning, will see their TBH records in current employee planning layout.
Fig. 55. Transfer HR calculations to CA function with FOX formula.
Fig. 56. Currency translation function.

1. **HR - Ver. to Ver. Copy Function.** Planning is done every quarter and new planning version is created for each planning cycle, but planners use the previous planning data.

   For example, if X40 is the planned version for first quarter of fiscal year 2008 and X41 is the new version for planning quarter two, then planners need to copy data from X40 to X41 for planning purpose. This function copies the data from one version to other version. The records copied from previous version are copied based on planners access and authorization. For example, planned version X40 will have data for whole company, so a planner with access to only US01 company code, will be able to copy only data records for US01 company code. Figure 58 shows Version to Version copy function details.
Fig. 57. Current employee planning layout.

Variables are set using variants set program discussed in “Variables Set utility program” section.

Figure 59 shows the variant selection, variables and values they will be set to on executing this program.

2. Delete Employees Function. This function is used to delete all the employee records from employee planning layouts. Recids deleted are restricted by planners access and authorizations. This is standard SAP provided function, which requires version and
value type to delete employee records. Figure 60 shows the function and the corresponding variables set program screen for executing delete function.

3. Copy From HR Function. This function is used to copy the HR Employee data into the employee planning layout. This actuals data is loaded into the HR infocube everynight, to get the most current data into BW system. Synopsys does planning for two years, hence, the data is copied for two years. The data to be copied is selected based on planners access and parameters to the copy function. Figure 61 shows the copy function,

This is standard SAP provided copy function, which copies data from one area to another area based on version, value type and planning area as input parameters. Since this function involves data movement between two different planning areas, this function has to be in multiarea, which can facilitate this movement of data.

4. Salary Based Calculation Function and Posting to HR Function. These two functions are same as described in TBH layout section earlier in this chapter. The only
difference is that the functions act on different set of data. The ABAP function module executed is same for as in TBH layout, but based on different set of data, the calculation logic is different within ABAP code.

**Workforce Planning Layout**

Workforce planning layout is used to perform employee terminations. This layout has two functions, one to change the date of termination and other to re-calculate
Fig. 60. Employee delete function and variants for the function.

the workforce based on the terminations made. Figure 62 shows the layout, with the two functions.
Expense Planning Layout

Expense planning is used to plan expenses within company at a cost element level. Each expense category is assigned to a cost element. Cost element is a numerical identifier to identify a particular expense category. Expense planning is done at cost center and cost element level in both controlling currency (Headquarter currency) and object currency (office location currency based on country in which office is located). Each expense category is assigned to a cost element (e.g., telephone is assigned to cost element 60200, supplies is assigned to 60201, printing is assigned to 60203, etc.). Figure 63 shows the expense planning layout along with its functions.

Figure 63 shows expenses for various categories for four quarters in 2008 in Canadian dollars since cost center 1525 is in Canada. The following functions are present within expense planning layout:
Fig. 62. Workforce planning layout.

- Actuals to Version Copy
- Quarter to Quarter Copy
- Version to Version Copy
- Depreciation Simulation Upload
- Refresh/Delete
- USD Translate Refresh

1. **Actuals to Version Copy Function.** This function copies expense data from Expense actuals cube ZBPSAEXPC to expense planning layout. Formula language is used to write copy program. The variables required to perform this function are shown in
Fig. 63. Expense planning layout.

Figure 64. These variables are set using the set variables utility. This function copies all the expense data from actuals based version to be copied to, value types and activity text. Since this involves the data transfer between two different areas, this function is in multi area, which includes both expense actuals area and expense planning area.

Figure 64 shows the variable set utility and variables set on executing this utility. As shown in the Figure 65, data is copied to target version X56 based on source value type 4 to target value type 60 and fiscal quarters specified below.

2. Quarter to Quarter Copy. This function is used to copy data from and to the specified quarters in the same version. The copy conditions and variables are set using the variable set program, which sets the required variables for the copy function. Figure 66 shows the variable set program screen.
Fig. 64. Variable set program for expense actuals copy.
Fig. 65. Expense copy function.

As shown in the Figure 66, executing the variable set program sets the variables for the copy function, as shown in Figure 67. Figure 68 shows the details of the function. Figure 68 shows the Planning area, planning level, and planning package to which the function belongs. Function is written in formula language, which is available with BPS framework. As seen in the Figure 68 it uses the variables set, using the variables set utility program.

3. Version to Version Copy. Version to version copy function within expense layout is used to copy data from one planning version to another version. Usually during the
planning process, expense information is copied from previous planning versions and to reflect the expenses till current period. At the end of the fiscal year, this creates a consolidated expense planning version for whole year. This function is written in FOX (Formula Language). The following code snippet shows the FOX formula for copying the data from one version to another version.
Fig. 68. Quarter to Quarter copy function.

DATA FRVERSION TYPE 0VERSION.
DATA TOVERSION TYPE 0VERSION.
DATA VERSION TYPE 0VERSION.
DATA FRVTYP TYPE 0VTYPE.
DATA TOVTYP TYPE 0VTYPE.
DATA QTR TYPE 0CALQUARTER.
DATA AMOUNT_EXISTS TYPE I.
DATA RESULTS TYPE KEYFIGURE_NAME.

FRVERSION = VARV ( ZBPSUS01 ).
TOVERSION = VARV ( ZBPSUS02 ).
FRVTYP = VARV ( ZBPSUS03 ).
TOVTYP = VARV ( ZBPSUS04 ).

*IF TOVERSION <> 'PPP' AND TOVERSION <> 'FFF.'
IF TOVERSION <> 'PPP'.
FOREACH RESULTS.
IF RESULTS = 'ZVALOBCUR' OR RESULTS = 'ZVALCOCUR.'
FOREACH VERSION.
IF VERSION = FRVERSION OR VERSION = TOVERSION.
AMOUNT_EXISTS = 0.

FOREACH QTR.
IF {RESULTS,QTR,TOVERSION,TOVTYP} <> 0.
AMOUNT_EXISTS = 1.
EXIT.
ENDIF.
ENDFOR.

IF AMOUNT_EXISTS <> 1.
FOREACH QTR.
{RESULTS,QTR,TOVERSION,TOVTYP} = 
{RESULTS,QTR,FRVERSION,FRVTYP}.
ENDFOR.
ENDIF.
ENDIF.
ENDFOR.
ELSE.
FOREACH RESULTS.
IF RESULTS = 'ZVALOBCUR' OR RESULTS = 'ZVALCOCUR.'
FOREACH VERSION.
IF VERSION = FRVERSION OR VERSION = TOVERSION.
FOREACH QTR.
{RESULTS,QTR,TOVERSION,TOVTYP} = 
{RESULTS,QTR,FRVERSION,FRVTYP}.
ENDFOR.
ENDIF.
ENDIF.
ENDFOR.
ENDIF.
ENDFOR.

When the function is invoked within BPS framework, it is supplied with versions, Key figure names, value type and quarter as parameters to copy function.

4. Depreciation Simulation. Simulating asset depreciation is one of the important aspects on any expense planning process. It provides information on all the assets owned by company, its current value and how it will be depreciating over a period of time. Asset
depreciation information is extracted from transactional systems into SAP BW outside BPS framework. Asset depreciation report is generated by running a BW query on the objects holds the information and downloaded to excel. This excel file is then uploaded into the expense layout to capture depreciation data as part of expense planning. Uploading file into expense layout is done using an ABAP function module. Figure 69 shows the function modules used to upload the depreciation information.

Fig. 69. Function Module to upload data.

As shown in the Figure 69 function module, Z_BW_BPS_DEP_DOM_UPL_ROUTINE written in ABAP is used to upload the data. Function module Z_BW_BPS_DEP_DOM_UPL_ROU_INIT is sued to do the initialization tasks, like file verification, data verification. etc.
CHAPTER VI

CONCLUSION AND ENHANCEMENTS

Conclusion

SEM BPS application provides a comprehensive financial planning system to address organizations planning requirements and provide the capability to drive flexible planning processes which otherwise are severely restricted due to complexity of planning process.

It will greatly reduce the planning time, increase efficiency and accuracy. This application will provide a greater insight into the business data and also reporting on that data in multi-dimensional manner, thus giving different views of the same data which will help executives in making well educated and timely business decisions.

Financial Planning is one of the most important aspects in any company’s decision making process and setting future financial targets for the company.

1. Planning helps identify future actions based on current data.
2. Set targets and route maps for getting there.
3. Communicate strategy and direction.
4. Set up the expected results so you can spot when things are going wrong.
5. Set targets to motivate performance.
6. Determine resource allocation.
7. Inform investors of likely expectations.
Future Enhancements

HR Variable Comp – Wage Types

Purpose. To populate BPS with compensation values/compensation percentages from each employee Record stored within the HR wage types (HR Database).

Current Function. Employee payscale type and grade are pulled for each employee in BPS, based on these values a percentage is derived from the HR Utility Program. For example, ee#1234 payscale type I2 (Infrastructure Basic) with grade 68 receives CIP at 14%. The forecasted amount is calculated from the pro-rated salary of the employee (Figure 70).

<table>
<thead>
<tr>
<th>Wage Element</th>
<th>Seq No.</th>
<th>Paysign</th>
<th>Paysign Units</th>
<th>Paysign Low</th>
<th>Paysign High</th>
<th>Paysign Units</th>
<th>Paysign Low</th>
<th>Paysign High</th>
<th>Paysign Units</th>
<th>Paysign Low</th>
<th>Paysign High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>01</td>
<td>1</td>
<td>30</td>
<td>76</td>
<td>1</td>
<td>80</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>02</td>
<td>1</td>
<td>30</td>
<td>76</td>
<td>1</td>
<td>80</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>03</td>
<td>1</td>
<td>30</td>
<td>76</td>
<td>1</td>
<td>80</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>04</td>
<td>1</td>
<td>30</td>
<td>76</td>
<td>1</td>
<td>80</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 70. Benefits table.

Desired Function. Capture these new compensation types and into HR actual and HR BPS transactional cube and post the new compensation values to GL accounts associated with wage type. This increases the flexibility of the planning process as any changes in HR database will be automatically reflected in planning framework.

Solution. To extract all the available wage type information from HR Database. Figure 71 shows the list of available wage types.
Flexibility. Flexibility of the solution is limited by the number of wage types available, currently 20.

Following is the list of tasks/activities needed to accommodate the new wage types within BPS:

1. Change extract structure.
   
a. Extract Structure for HR actual cube needs to be changed. Need to add 20 wage types and corresponding values to the structure (i.e. add 40 new fields).
2. Change Data source.
   a. Data source corresponding to the above mentioned extract structure will have to be changed.

3. Change Extractor.
   a. Extractor need to be changed/re-written to extract new information from employee master data table into HR actual cube.

4. Change HR actual Cube.
   a. Add 40 new info objects corresponding to new wage types and values.

5. Change BPS HR transactional cube.
   a. Same as mentioned in step 4.

6. Change posting function, to post the new values to corresponding GL accounts.

7. Change affected planning levels and functions (need to find the details on this).

8. Change HR layout (need to identify what changes are be done; depends on the requirement to change/see the new data).
REFERENCES
REFERENCES


