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In this SAP BW Consulting, inc. How-To guide, we will share some of our SAP BW Data Modeling Tips & Techniques Part I
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Introduction to Data Modeling

In traditional Entity Relationship Modeling, the core concept is very simple. It essentially boils down to the fact that at an elementary level, a thing, say a product, is related to another thing, say a customer. The entities, Product and Customer, in this case, are related in some way. The relationship is the key point, as it can be one-to-one, one-to-many, or many-to-many and is traditionally denoted with the following symbols.

![One-to-One](image)

![One-to-Many](image)

![Many-to-Many](image)

To make these relationships mean something to the two entities, you need a key, or a way to link the two. As we will discuss later, keys are everything!

Traditional Entity Relationship Modeling

In his book, Case*Method: Entity Relationship Modeling, by Richard Barker, 1990, the subject of Entity Relationship Modeling is dealt with at length. Not much has changed since this book was written, but I believe for an even more in-depth understanding you would be well served by reading the book, “Data Model Patterns, Conventions of Thought” by David C. Hay. In this second book, you will find data model patterns for virtually any business scenario you are liable to run across.
The diagram above is meant only to give you an idea of what an Entity Relationship Diagram looks like. In a full sized system design, the ERD may have hundreds if not thousands of entities all connected in a similar fashion.

Without attempting to provide a complete treatment on Entity Relationship Modeling, I would like to just make you aware of the following five points:

1. The existence of Many-to-Many, denoted as M:M, usually indicates the existence of an unidentified intersection entity. In the example above, this missing entity might well be Purchase Order, which would have both header and detail section entities.
2. There exist a concept called Normalization, which ranges from 1\textsuperscript{st} degree to 5\textsuperscript{th} degree of normalization. There are certain modeling precepts that dictate which level you must take the normalization too.
3. There are many modeling concepts that drive you to intentionally introduce redundant normalization techniques.
4. When converting from the ERD model to the Star Schema, the structure of relationship modeling changes, however, one key element remains of vital importance, the identification of and proper utilization of Primary, Secondary, Compound and Foreign Key relationships. Within the realm of
ERD, these keys connect the Entities. Within the Star Schema, they become DIM ID, and SID IDs, and serve the same basic purpose.

5. Within ERD models, the database management system takes care of the indexes and internal hash tables (a complete separate and complex subject itself) with far less involvement required of the DBA, although some remains necessary. Within the SAP BW Star Schema based system, the effort to keep these keys, i.e., DIM and SID keys, requires effort on the part of the functional SAP BW consultant, the SAP BW BASIS Administrator and can largely but totally be automated via proper use of process chains.

What is especially important to realize is that the use of CASE or Computer Aided System Engineering tools, of which there are several vendors, allows you to quickly model not only the Entity Relationship Diagram, but as well, the Process Flow Diagram, Function Hierarchy Diagram, and to directly generate complete functional systems from the tools. This author’s expertise was in the use in the Oracle Designer 2000 tool set, now much evolved, to generate fully functioning business systems. There currently are no such tools for developing SAP Extended Star Schema’s nor of going straight to the fully functioning system you need. There is, however, a vast library of what is referred to as SAP Business Content and a couple of minimally useful tools available from SAP to navigate the SAP Business Content. This is why you must have SAP BW consultants who not only know the SAP BW Tool, but who also have read and are knowledgeable of the contents of the SAP Business Content, and can translate from the Business Content to your Business Requirement.
SAP Business Warehouse Data Modeling

Within the realm of SAP Business Warehouse Star Schema Data Modeling, your models are typically much simpler then ERDs, as you are modeling a specific business area. The SAP implementation of the Star Schema is called the **Extended Star Schema**.

SAP Extended Star Schema Diagram

What is most significant about this approach is that data is no longer stored in the Dimension Tables. Instead, Master Data and attributes of Master Data, such as Customer and Customer Addresses, are stored in external tables and linked to the Dimension tables via SID or Surrogate Identification Numbers and the Dimensions are linked to the Fact Table via DIM ID or Dimension ID Numbers.

This approach offers several benefits, the most important of which is that NO data other than keys is stored in dimension tables. This means you only have to load and store data, i.e., customer name and address, once and it can be used in other infocubes or infoproviders. With an estimated loss to the U.S economy of more than $600,000,000,000.00 (yes, billion) from bad data, this is a critical improvement and one of several methods being used to reduce data errors.

The challenge facing all **SAP BW Data Modelers** is how to transform the entity relationship model to the **SAP Extended Star Schema**. The method SAP recommends is to transform the ERD into the Bubble Model, as shown in the next diagram. In this case, I have used a model of the Airline Route Profitability model, which is not part of the standard SAP Business Content but is of critical importance to the Airline Industry! It is also applicable to the Transportation Industry in
general, including 3PL (3rd Party Shippers), Railroad operators, Ships, Ferry’s and Bus companies. For the purpose of introducing SAP BW Consulting Extended Star Schema Best Practices, it will serve our purposes just fine.

**Airline Route Profitability Bubble Diagram**

In our **Bubble Diagram** above, we have seven dimensions defined around a central fact table related to Route Profitability. For the purposes of clarity, we have not shown that the Master Data, say for Fleet, is stored in external Master Data Tables.

**Special Note to Experienced Oracle Entity Relationship Modelers:** You may recognize that the typical scenario used for teaching ERD is the airline reservation system. Please be aware that this model, **Airline Route Profitability**, is not the same model although the principles are the same. In fact, you will not find a generally available public model of the Airline Route Profitability model as each airline does this in unique ways and consider it their most critical measurement of merit.
SAP BW Consulting Data Modeling Best Practices

There are two basic approaches to SAP BW Data Modeling:

1. The Top Down Key Figure Based Approach
2. The Bottom Up DataSource Approach.

The main approach you should focus on using is the Top Down Key Figure based approach, especially when performing your Business Content check.

<table>
<thead>
<tr>
<th>Key Figure Based Approach (Top Down)</th>
<th>Data Source Approach (Bottom Up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get a clear understanding of your logical data model</td>
<td><strong>Focus on the Business Process of your system</strong></td>
</tr>
<tr>
<td>Break down the granularity of your performance indicators to basic key figures</td>
<td><strong>Check your Datasources for particular measures (KPIs)</strong></td>
</tr>
<tr>
<td>Find and compare your base key figures with the Business Content Repository</td>
<td><strong>Look up DataSource for Characteristics defined in dimensions in your logical data model</strong></td>
</tr>
<tr>
<td>Compare the Scenarios of your logical data model with the Business Content Infocubes, Queries and Workbooks</td>
<td><strong>Understand how Business Content maps to the fields you found to InfoObjects</strong></td>
</tr>
<tr>
<td>Check for performance indicators (KPIs) in Business Content Queries</td>
<td></td>
</tr>
<tr>
<td>Investigate the data flow for identified Key Figures</td>
<td></td>
</tr>
</tbody>
</table>

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Key Figure Based Approach

The Key Figure based approach looks like the below diagram in process flow form.

- The main approach during the Business Content check should be a top-down approach. If the search for corresponding Key Figures is not successful, a bottom-up approach in the special case may be the best solution.
- You must understand the business concept behind this model. Technical descriptions will never reveal a 100% solution.
- Key Figures (also known as Performance Indicators or measures, depending on the culture you are working in), may be available in the business content, and you will normally find them modeled as Calculated Key Figures. If you do not find a KPI that exactly matches the KPI you are looking for, it may only mean that either:
  1. It is available but is called something else
  2. The components needed to create your KPIs may be located in separate pieces within your Business Content or are located in Multi-providers.

A. As you can see, this indicates and validates why you must have spent a considerable amount of time understanding your own business and the SAP Business Content in order to develop a valid model!
- There is a SAP Business Content Browser available in the SAP BW Business Content, but it is normally not installed nor available, unfortunately. All of the publicly available business content is located at help.sap.com under SAP Netweaver. It is no longer available in one spot nor as a separate off-line pdf document, so it requires a great deal of time to find, study and employ in your environment.

- When analyzing SAP Business Content, focus on the following issues:
  1. Business Context to compare Business Scenarios. Often times, unrelated business areas, have models that, at heart, look the same and can be leveraged.
  2. Check Compounding, Dimensions and the availability of Key Figures. For instance, Key Figures required to compute your KPIs may be available in Multi-Providers or could be modeled that way. Investigate whether Dimensions within Infocubes can be redefined as navigational attributes.

- Verify that Business Content KPIs are calculated the same way your KPIs need to be calculated.

- Investigate and understand all provided dataflows and extractors. Extractors may need to be extended to provide all the data elements required for your scenario.

**Bottom-Up Scenario**

The Bottom-Up or DataSource based approach looks like the below diagram. The use of the bottom up approach mainly depends on whether you are running a SAP R/3 driven system (meaning most if not all of your source data will be coming from one or more SAP R/3 systems)
1. Assumption: Project is based primarily on SAP R/3 or R/3 is at least part of the sourced systems. If either of the two conditions are the case, then the bottom up approach is recommended.

2. The major advantage of this approach is that the customer already speaks or should be vaguely fluent in SAPenese. What is SAPenese? Well, it is the specialized language of the SAP software system, which sounds like space aliens talking when outsiders hear it. Like any specialty, such as aviation, a unique language evolves and SAPenese is the result. For the SAP BW consultant, this greatly facilitates conversations about business requirements and allows you to find relative SAP Business Content far easier than in the Top Down approach.

3. Once you have analyzed the SAP DataSources, meaning you have taken a look at, for example, how Purchase Order number ranges are defined in the Material Management IMG (Implementation Management Guide), you can find corresponding Infosources (and extend them if necessary to support your scenario).

4. There is a nearly 100% chance your system environment will not be purely SAP. However, if you can find what you need in SAP and find the corresponding infosource equivalents in the other systems, it is far easier to match the datatypes and get them into SAP BW. If you are in a mixed Oracle and SAP environment, there are several third party vendors who have done the mapping and matching for you and we recommend you investigate their usage, budget permitting.
Determining Data Flows

Your data model will determine your required dataflow. Once modeled, you can always view your dataflow using the metadata repository browser, which provides you a snapshot of your end-to-end dataflow.
Modeling SAP BW Multi-Providers

A SAP BW Multi-Provider is used to combine data from Infoproducer and to make it available for reporting. The Multi-Provider doesn’t actually contain any data itself as it is more or less equivalent to a database view.

The design of effective Multi-Providers is critical to success with the SAP Business Warehouse. During the Requirements Analysis phase of your SAP BW project, you must decide upon the following design elements:

![Diagram](image)

**Granularity of the Data**
- Time Granularity (This can range from seconds to years)
- Aggregated or detailed data
- Snapshot/Inventory

**Data Volume**
- Number of Documents
- Number of Products
- Number of Years to report on (History)

**Required Analysis Features**
- Analysis Method
- Multi-dimensional or Flat File Reporting (or a combination of both)
- Required Response Times
- Urgency
- Real-Time or some lag time allowed

The above diagram shows how you can connect virtually anytime of infoprovieder into a multi-provider. Each particular analytic requirement will involve slightly different connections among the various providers. The secret is to provide what the user needs without bogging down the system with too much data.
SAP BW Consulting Data Modeling Value Proposition

This is part one of a series of How-To Guides we provide on SAP BW Data Modeling. We will provide a complete treatment of the subject in a series of upcoming How-To guides. This is one of the most critical areas of knowledge for the SAP BW consultant. From a customer value perspective, it is THE MOST CRITICAL ASPECT of your BW system.

Without a solid, robust data-model, you will not be able to build or use the query’s your business users need.

As Senior Level SAP Business Warehouse Consultants, we are frequently confronted with the following questions from recruiters which is why we believe you should be using our services.

Questions which indicate lack of knowledge and for which only deep SAP BW expertise can answer.

1. Do you work on the front-end or back-end?
   a. If the Data-model is not designed properly to support your current analysis requirements, by default, the SAP BW Consultant has to work on both the front-end and back-end of the system. From a purely technical standpoint, there is no such thing as front and back end. There are only components that provide various required functionalities.
2. Do you specialize in a particular SAP BW-SAP functional area? Translation: Do you know SAP Financials, SAP Logistics, SAP Human Resources+SAP BW.
   a. SAP does not provide any training courses for SAP BW-FICO or any other area of SAP BW + SAP R/3 functional knowledge. A SAP BW Consultant, if he claims knowledge of one of the SAP Functional Areas plus SAP BW got it in one of the following ways only:
      i. Was a SAP Functional Consultant in one of the SAP Modules, such as MM or SD or FI/CO. Then he decided to become a SAP BW consultant.
      ii. The SAP BW Consultant worked on an implementation project on the business side in one of the functional areas roughly related to say, finance or logistics.
      iii. Gained some knowledge of the SAP functional module, such as SAP Finance or SAP Human Resources, from working as a SAP BW consultant on a project where he happened to work on that area. In these cases, the functional knowledge will be limited to only those functional areas covered during that particular project.

3. Do you specialize in a SAP BW Industry specialty?
   a. SAP does not provide any SAP BW Industry Training nor does it provide SAP BW Content for all SAP Industry Solutions.
      i. A SAP BW Consultant can only have gotten SAP BW Industry experience in one of the following ways:
         1. Worked on a SAP BW Industry Solution implementation, such as Airline MRO operations and learned some of it, on-the-job.
         2. Worked in a specific industry prior to joining SAP, but then will be limited to knowledge about the particular area he worked in within that industry before becoming a SAP BW Consultant.

Our value proposition is based upon three primary principles:

1. All of our SAP BW consultants are either SAP Certified or are working toward it. Our philosophy is simple when it comes to SAP Certification. SAP Certification may not make you a good consultant, but it does indicate you have put in some time studying the available material. Being a company founded by pilots, embedded software system engineers and ex-military maintenance officers, we are, by nature, very demanding of our team.
2. We know that the available SAP Training Material is, unfortunately, limited, of less than military class quality and usually somewhat out-of-date. To fix that, we produce these How-To Guides. They represent our deep experience in the industry and our background in engineered software systems.
3. We are fortunate to work in an industry that continues to exhibit a high-demand for expertise like ours. We are limited in numbers with huge growth targets, and our success depends upon:
   a. Providing our customers with high-quality, high value solutions and proving the value.
   b. Creating high-performance Business Analytics Consultants by continuously recruiting, training, measuring and improving our consultant’s skills.

We also know that in today’s ever more constrained budgetary environment, we must provide our clients with the means to estimate what their BW project will cost and what benefit(s) it will provide the business. To that end, we have developed two tools, the SAP BW Resource Calculator.

The BW Resource Estimation Calculator is available for download [here](#), and we encourage you to download and give it whirl. However, we would highly recommend you engage with us to walk you through it as the subject matter requires extensive knowledge of the SAP BW product.

The other calculator we provide focuses on the use of SAP BW to enable Throughput Accounting capabilities, which is something unique to SAP BW Consulting, inc.