Introduction to the SAS® 9 Business Intelligence Platform: A Tutorial

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Abstract

Business intelligence (BI) is a broad category of application programs and technologies for gathering, storing, analyzing, and providing access to data to help enterprise users make better business decisions. BI applications support the activities of decision support, query and reporting, online analytical processing (OLAP), statistical analysis, forecasting, and data mining. BI includes a set of concepts and methods to improve business decision making by using fact-based support systems.

This tutorial will guide participants through the landscape of business intelligence and how it has been implemented in SAS 9. We will provide a broad overview of what things we can accomplish with BI, lay the groundwork for continued learning and discuss the tools and technologies and how they interact in some common architectural scenarios. The goal of this presentation will be to get users comfortable with the concepts and vocabulary of BI. We will also provide a demonstration of the capabilities of the SAS suite of BI tools and summarize which tools are best for the various functions we have to perform using real world examples.

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Introduction

Business intelligence (BI) is about creating value for our organizations based on data or, more precisely, facts. While it seems like another buzzword to describe what successful entrepreneurs have been doing for years, if not centuries, that is, using business common sense. From a modern business-value perspective, corporations use BI to enhance decision-making capabilities for managerial processes (e.g., planning, budgeting, controlling, assessing, measuring, and monitoring) and to ensure critical information is exploited in a timely manner. And computer systems are the tools that help us do that better, faster, and with more reliability.

Defining BI

Business Intelligence is the art of gaining a business advantage from data by answering fundamental questions, such as how various customers rank, how business is doing now and if continued the current path, what clinical trials should be continued and which should stop having money dumped into!

With a strong BI, companies can support decisions with more than just a gut feeling. Creating a fact-based "decisioning" framework via a strong computer system provides confidence in any decisions made.

History of BI

Business intelligence is not just a modern idea. In his famous treatise *The Art of War*, Sun Tzu says,

"...what enables the wise commander to strike and conquer, and achieve things beyond the reach of ordinary men, is foreknowledge. Now this foreknowledge cannot be elicited from spirits..." (Giles, 1994)

While Sun Tzu is not the father of business intelligence, his concept that foreknowledge breeds success applies directly to BI. Modern BI uses computers to gain foreknowledge by processing and analyzing information in support of business decisions.

In the 1980's Executive Information Systems (EIS), in the 1990's, OLAP, followed by scorecards, dashboards, KPIs (key performance indicators), and real time alerts through business activity monitoring.

BI was coined by Gartner (Dresner, 1989) as an umbrella term to describe the set of concepts and methods used to improve business decision-making by using fact-based support systems. Regardless of the moniker we give BI, it is certain that it is here to stay.

BI Product Landscape

Business intelligence is not necessarily about tools and technologies; rather it is a strategy of combining data from various sources with methodologies that make those facts solidify in a cohesive manner.

The data part of this strategy is *data warehousing* (see Figure 1). Once the data is sourced, scrubbed, enriched, conformed, and finally housed in "access-ready" formats BI tools can make the data sing and dance.
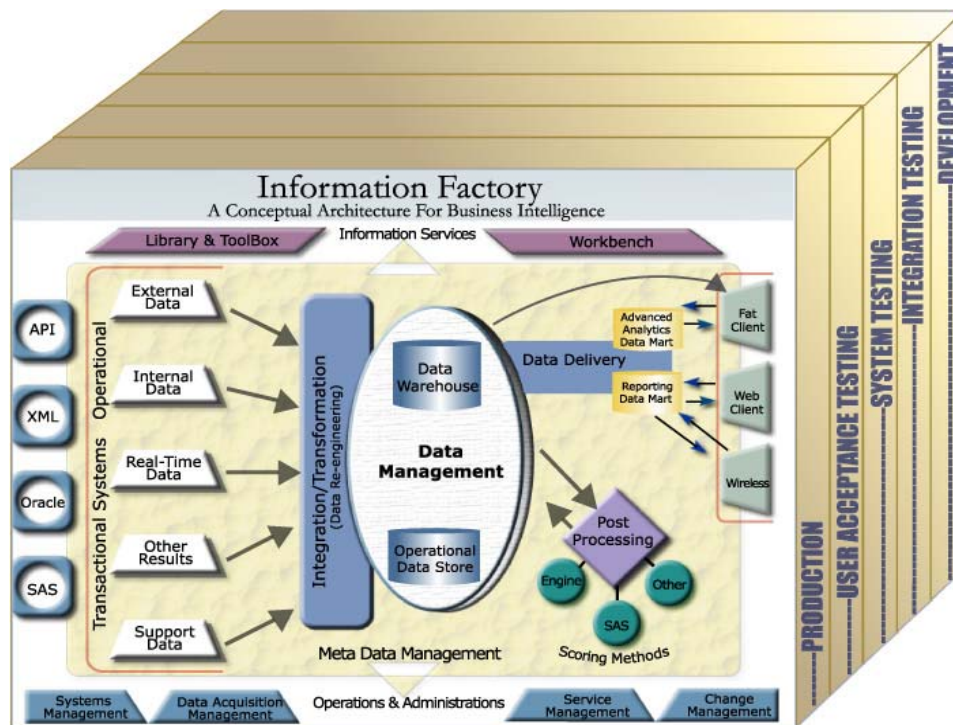
Figure 1. Corporate Information Factory.

In Figure 1 above (adapted from Inmon, Imhoff and Sousa, 2002), BI is traditionally found in the Data Delivery area (to the right side of the Information Factory.)   Operational BI, on the other hand, is reporting and analysis done directly off of the operational systems or via an Operational Data Store (for example see, Imhoff, 2001.)

Traditional BI makes use of past data points (what you know about the data from a historical perspective) and displays it for the end user to make important inferences. The historical reporting takes advantage of the dimensionality in the data to "slice and dice" by reporting facts along any number of dimensions.

Early reporting tools allowed programmers to define exactly what they wanted to present in varying levels of granularity and aggregation. In the 1980's a plethora of OLAP style data structures emerged, which included MOLAP, ROLAP and Hybrid-ROLAP. All of which provided the ability to drill in, around and through to make sense of the data presented.

While OLAP is certainly not dead, highly structured interfaces to the data came out of an organization's executive branch interested in the details. In other words, taking data from "green bar" and simply transferring it to the "browser" was not enough.

Management needed to synthesize the data into meaningful bits of information. "Tell me what's wrong. Highlight the facts for me," was the driving force behind the dashboard and scorecards in today's electronic toolbox.

Reporting on the past can only show what has happened, not what the future may bring. Past information must be combined with some real-time information and then layered with analytics in order to have true foreknowledge.   This is where data mining, forecasting and other predictive analytics play an important role. This also turns out to be a major differentiator for SAS relative to its competitors.

SAS and BI

Having just celebrated 30 years of providing software for decision support, it is safe to say SAS has always done BI. From the early days of helping agricultural universities share statistical algorithms to supporting Fortune 100 companies today, SAS solutions take data and make sense of the patterns and provide flexibility and power in how to display and share information.

In SAS software, Business Intelligence includes:

- A set of client applications designed for a specific type of business or analyst

- SAS server processes designed to provide specific types of services for the client applications

- A centralized metadata management facility

In the figure below, the Business Intelligence tools are highlighted.

Figure 2. SAS Information Value Chain

SAS BI as a product set comes in two flavors: Business Intelligence and Enterprise Business Intelligence. The table below highlights which products are included in each package.

BI Server	Enterprise BI Server
• Base • Graph • Integration Technologies • Metadata Server • Information Map Studio • Add-in for Microsoft Office • Web Report Studio • SAS Management Console • Query and Reporting Services	*BI Server Components, plus:* • Information Delivery Portal • OLAP Viewers for Java and .NET • OLAP Cube Studio

While the list above is certainly not comprehensive of all of the BI capabilities within SAS, it certainly represents a large portion of what SAS can do to support BI initiatives. Other developer-centric tools, which help support the delivering of information, include SAS/IntrNet and AppDev Studio.

Of course the analytic engines that set SAS apart from its competitors include products for data mining, forecasting, quality assurance and statistics. These engines can be plugged into the core BI products to support the specific capability of the BI environment being developed.

Understanding the Users' Perspective

From a functional perspective, the most common applications for any SAS solution are planning, budgeting, financial consolidation, compliance reporting and forecasting, general data warehouse reporting/ dashboarding, and sales and marketing analysis.

SAS can do all of these things using a variety of approaches (pieces and parts of the BI platform). One of the ways to look at all of these tools is by looking at the features and functions of BI offerings in general then map these appropriately to the SAS offerings.

FEATURES AND FUNCTIONS

- **OLAP (On-line analytical processing)**—refers to the way in which business users can slice and dice their way through data using sophisticated tools that allow for the navigation of dimensions such as time or hierarchies. Usually the display is some numeric measure such as "sales dollars."

- **Query and Reporting**—being able to ask questions of the data that may not have been asked before. That is, reports constructed to answer novel questions or where the presentation is not yet defined. Once generated, the report (or just the report instructions) can be saved for future viewing.

Querying usually involves users entering SQL or an English-translation of SQL commands and an immediate execution environment where results can be viewed.

- **Advanced Analytics**—sometimes referred to as data mining, forecasting or predictive analytics, this takes advantage of statistical analysis techniques to predict or provide certainty measures on facts.

- **Collaborative BI**—refers to the concept of taking structured data, analysis and/or reports and combining unstructured content (such as comments, discussions, attachments) so that facts can be augmented by additional content.

- **Corporate Performance Management (Portals, Scorecards, Dashboards)**—this general category usually provides a container for several pieces to plug into so that the aggregate tells a story. For example, a balanced scorecard that displays portlets for financial metrics combined with say organizational learning and growth metrics.

- **Proactive BI (BAM)**—also known as real time BI, allows for the real time distribution of metrics through email, messaging systems and/or interactive displays.

Taken together, they create BI. That is not to say all of these must exist in a single system in order to be consider a BI environment, but some or all of these must be present.

The list of features here features the capability of SAS tools.

SAS Business Intelligence Facilities

THE BI ARCHITECTURE
The SAS Intelligence Platform consists of a multi-tier environment, typically represented by the

- Client tier

- Middle tier

- Server tier

In the most basic terms, if an application is installed on the machine the user is sitting at, that machine is the client tier. There are three different types of SAS client applications.

- **Java clients**—run in a Java run-time environment (JRE) and installed on the machine where it is used.

- **Windows clients**—run in the Microsoft Windows environment and installed on the machine where it is used.

- **Web clients** run in a Web browser by connecting to a Java Application Server or Servlet Container on the middle tier. Only the Web browser is installed on the local machine.
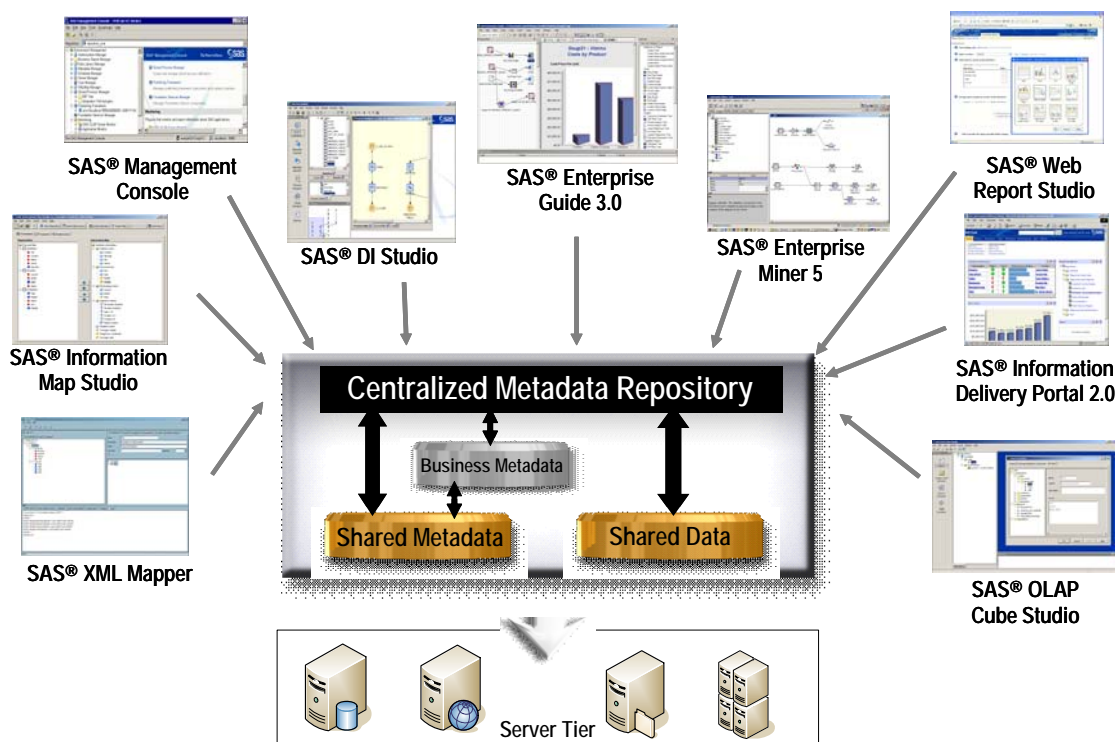
Figure 3. SAS Clients interacting with a centralized metadata server

Recent experience has shown many customers new to the SAS 9 environment are bewildered by the seemingly huge array of different client tools available.

Now for the secret sauce that separates SAS among its competitors. SAS adopted a strategy when designing the SAS 9 architecture based upon user personas, or roles, each representing a part of the life cycle of BI—from source databases through IT, to power users, decision makers, and operational staff—SAS organized its BI client tools into categories along the following lines.

Task	Role	SAS Tool
Administrative and Configuration	IT	SAS Management Console
Development	DBAs, SAS Programmers	SAS DI Studio SAS Enterprise Guide SAS OLAP Cube Studio
Report Creation	Subject area experts	SAS Add-in for Microsoft Office SAS Web Report Studio
Data Exploration	Statisticians/ analysts	SAS Enterprise Miner SAS Forecast Server (client)

Task	Role	SAS Tool
		SAS STAT Studio
Information Consumers	Operational staff, management, decision makers	SAS Information Delivery Portal Web Report Viewer SAS Add-in for Microsoft Office SAS Web OLAP Viewer

In terms of the general BI features and functions listed above, SAS capabilities can also be categorized as follows:

- **OLAP (On-line analytical processing)** —the assumption here is that OLAP requires some kind of multidimensional structure (MOLAP), like those supported by the **SAS OLAP Server** and **SAS OLAP Cube Studio**, and exploited through the **SAS Information Delivery Portal** via Information Maps, SAS provides ROLAP capabilities through **SAS Web Report Studio** and **SAS Enterprise Guide**.

- **Query and Reporting** —**SAS Web Report Studio** allows data to be exploited through Information Maps and Stored Processes. Information Maps in particular provide a very powerful way to deliver filtering criteria and data roles to the business while hiding the complexity of the underlying data structure.

- **Advanced Analytics**—any SAS process can be encoded as a Stored Process to allow non-technical users to run on demand. Stored Processes can be exploited through a variety of tools in the BI Platform.

- **Collaborative BI**—**SAS Web Report Studio** provides a mechanism for adding descriptive text to data-derived report entities. Also, the **SAS Information Delivery Portal** has some collaboration functionality in the form of a built-in metadata search engine, and the ability to bookmark and share reports.

- **Corporate Performance Management (Portals, Scorecards, Dashboards)** —the **SAS Information Delivery Portal** is a solid framework for dashboards. The forthcoming **BI Dashboard Framework** provides a set of easily-used widgets to assemble dashboards and scorecard-type reports.

- **Proactive BI (BAM)** —SAS provides some of the plumbing for event-based BI in the form of alerts via the **SAS Information Delivery Portal** in Enterprise BI Server. However, there is no 'out of the box' event management or rules engine. Please refer to ThotWave's Event System for a third party offering (Nelson and Wright, 2005)

A Glossary of SAS BI Clients

. One of the most powerful aspects of the SAS 9 BI environment is the ability to create centralized definitions of business logic (i.e., SAS programs via Stored Processes) or data (via Information Maps) and to automatically have those definitions available across the business via a variety of tools designed specifically

for particular purposes. The SAS9 Enterprise BI Server facilities for surfacing data tools are considered to be the most important 'integration points' of the SAS BI Platform.

WEB REPORTS

Web Report Studio is a point and click interface for creating and executing reports. Reports may consist of both tabular data and business graphs. Web Report Studio is a zero-client install web application. Power users or IT professionals typically use it to create reports or perform ad hoc analysis of data.

The general population of users can run web reports with the Web Report Viewer. Web reports can also be parameterized.

Data access for web reports relies on creation of an Information Map. An Information Map is a simplified view of underlying SQL or MDX data with pre-defined joins, user-friendly labels for data, and other metadata to guide business users through information.

STORED PROCESSES

A Stored Process is a parameterized SAS program registered in the SAS Metadata Server that can run on demand. Because a Stored Process is a program, it has access to the full range of data access and analytic capabilities of the SAS system.

Stored Process output may be in a variety of formats, including HTML, RTF, and PDF. Output can be streamed back to the user on demand, or can be stored on a server for later consumption or wide distribution.

End users can run Stored Processes on demand from the Information Delivery Portal, from the Add-in for Microsoft Office, and from Enterprise Guide. Note these users do not need to have any technical expertise in SAS.

Creating a Stored Process is a programming exercise. The normal tool for creating a Stored Process is either Enterprise Guide or a desktop installation of SAS.

INFORMATION DELIVERY PORTAL

The Information Delivery Portal (IDP) is a Java-based web portal used as a single point of access to all SAS web-based applications. Web Reports and Stored Processes can be executed from within IDP. Data described by Information Maps can be directly explored in an "ad hoc" fashion. Also, the IDP provides a user-friendly search engine for SAS content defined in the metadata, including Stored Processes, Web Reports, OLAP views and packages of pre-created report content.

Some features of the Information Delivery Portal require the Xythos WebDAV server, a third-party product supplied with the Enterprise BI Server.

• Executing stored processes in background and storing results to WebDAV

• SAS publishing framework features for publishing portal content and packages to WebDAV

• Browse/view files WebDAV

• Alerts

BI FRAMEWORK

The BI Framework (to be released pre-version 9.2) is a web-based tool that works with the Information Delivery Portal to display dashboards of Key Performance Indicators (KPIs). Although not formally announced, the BI Framework should provide the following features:

- KPI data can be obtained from an Information Map, a Stored Process, a SQL query, or a custom JDBC data source

- A library of static images for associating a status icon ("traffic light") with a range/threshold for the KPI. Custom images can easily be incorporated.

- Custom gauges used to display KPIs as a graphic that dynamically reflects that KPI value

- The display for a KPI can be a custom graph generated by a stored process

- Dashboards configured to auto-refresh on a defined time interval

- A drill-down URL associated with each KPI in order to surface details

ENTERPRISE GUIDE

Enterprise Guide is a tool for programmers and power users to write SAS programs. In addition to a traditional text-based programming environment, it also offers a graphical programming environment and guided tasks (wizards) for performing many common analytic operations.

Enterprise Guide is a native Windows application installed for each user. It communicates to a SAS server for analytic processing.

ADD-IN FOR MICROSOFT OFFICE

The Add-in for Microsoft Office allows SAS analytics to be directly integrated in Microsoft Office applications, such as Excel, Word, and PowerPoint. The SAS features run stored processes, access SAS data, and perform some of the same types of guided tasks as in Enterprise Guide.

SAS processing with the Add-in for Microsoft Office occurs on a SAS server and is subject to the same security model as all SAS operations.

Future of BI—Business Intelligence 2.0

This paper is a whirlwind tour of BI and the SAS offerings that support BI initiatives.   As it relates to modern computing, the concepts behind BI have been in use for decades. One of the paradigm shifts noted in recent years is moving beyond simple reporting to proactive analysis of the data and providing prescriptive recommendations on how to interpret the data. This, of course, relies on the fact that corporations can successfully move from caring about what happened in the past to a desire to not only know what's wrong but what is likely to get worse if nothing is done. That is where the power of advanced analytics plays such a powerful role.

What lies ahead if the leap can be made that tools like reporting, querying, OLAP, dashboards, scorecards and portals can be successfully used to help make sense of the world around us?

Wikipedia defines BI like this:

> *… a business management term which refers to applications and technologies… used to gather, provide access to, and analyze data and information about…company operations. Business*

> *intelligence systems... help companies have a more comprehensive knowledge of the factors affecting their business, such as metrics on sales, production, [and] internal operations...[BI systems] can help companies... make better business decisions. (Source: Wikipedia, 2007)*

Or, more simply put seeing data as a multidimensional component organized in the best way possible for the greatest understanding. Remember, true business intelligence analyzes data in order to gain a business advantage.

There is a concept called Business Intelligence 2.0 (BI 2.0) or the next generation of BI. The focus is on empowering users to freely access and share the information most relevant to their needs. There are, of course, a number of interpretations of what BI 2.0 is (or should be) but we (ThotWave) believe that BI should not only do what we've been promised to date (ubiqitous information at your fingertips) but also just in time (aka real-time BI) and BI should necessarily involve a collaboration component making BI part of the fact-based decisioning system where facts come from tacit and explicit data sources.

The goal of every entrepreneur should be to achieve beyond ordinary (business) men through foreknowledge, as Sun Tzu put it. A corporation's foreknowledge comes from a comprehensive look at all the available data. This can only be accomplished through a strong technological strategy built around reliable tools.

Gaining an understanding of BI will move any company from simply delivering reports to enabling interactive analysis and information sharing. When BI is integrated into everyday business processes, corporations stay focused on what to achieve, not only what has been accomplished.

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Biography:

Greg Nelson, President and CEO

Greg has recently started his third decade in the SAS eco-system as a programmer, analyst, architect and teacher. Greg is the President and CEO of ThotWave Technologies where he supports customers in a variety of industries. Prior to ThotWave, Mr. Nelson spent several years in consulting, media and marketing research, database marketing and large systems support. Mr. Nelson holds a B.A. in Psychology and PhD level work in Social Psychology and Quantitative Methods.

About ThotWave

ThotWave Technologies, LLC, is a Cary, N.C.-based consultancy and market leader in real-time decision support, specializing in regulated industries such as life sciences, energy and financial services. ThotWave recognizes the difference between simply accessing data and making data work for business. ThotWave commands the juncture of business and technology to help companies improve their operational and strategic performance. Through products, partnerships and services, ThotWave enables businesses to leverage data for faster, more intelligent decision making.

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