Paper 028-2009

Building Your First Dashboard Using the SAS® 9 Business Intelligence Platform: A Tutorial

Gregory S. Nelson
ThotWave Technologies, Cary, North Carolina

Abstract

A dashboard is a visualization technique that provides an immediate view or snapshot of exactly where you are in a specific process relative to your stated goals and objectives. Visuals indicators, such as temperature gauges, traffic lights and speedometers, help give you a real-world sense of your present progress and assist you in making decisions, adapting to current conditions or drilling into more detailed information. In a previous paper (Wright, 2008), we outlined technologies that can be used to build dashboards and we further that discussion with information that will help you build your first dashboard. We then walk through the process of building your first dashboard step by step by step, beginning with design considerations and SAS options for creating dashboards, then continue with defining some key performance indicators (KPIs), connecting our data, customizing the visual indicators and then learning more about ways to make the dashboard actionable through drill down and click-through. Finally, we will conclude with a discussion of additional customizations that can be performed with the SAS Enterprise Business Intelligence Platform.

Table of Contents

Introduction

BI, or Business Intelligence, is a term coined by Gartner (Dresner, 1989 cited in Computerworld article) as an umbrella term to describe the set of concepts and methods used to improve business decision-making by using fact-based support systems. Most people think of BI as reporting and querying through the web but it should be noted at BI can also include the visualization of metrics through OLAP viewers, scorecards, dashboards or even the results from analytic processes.

Business intelligence (BI) is about creating value for our organizations based on data or, more precisely, facts. 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 Dashboards

If BI is the "art of gaining a business advantage from data" by answering fundamental questions, then a dashboard is our visual interface into that data. Dashboarding, while a descendant from the Executive Information Systems (EIS) of the 1980's, has grown more directly out of the work with balanced scorecard and it's emphasis on key performance indicators. The concept of the balanced scorecard (see Kaplan and Norton) posits that in order to get better as an organization, you need to create a strategy first and it is with this strategy that comes out individual metrics that you can use to measure the progress of the organization – all tied directly and specifically back to organizational objectives.

In fact, a study conducted by Bain and Associates found that organizations that out-performed other companies ("satisfactory") had a number of differentiators between them and their "satisfactory" counterparts. Having a "clear vision and priorities" as well "measuring things that matter" no doubt helped these companies outperform their competitors.
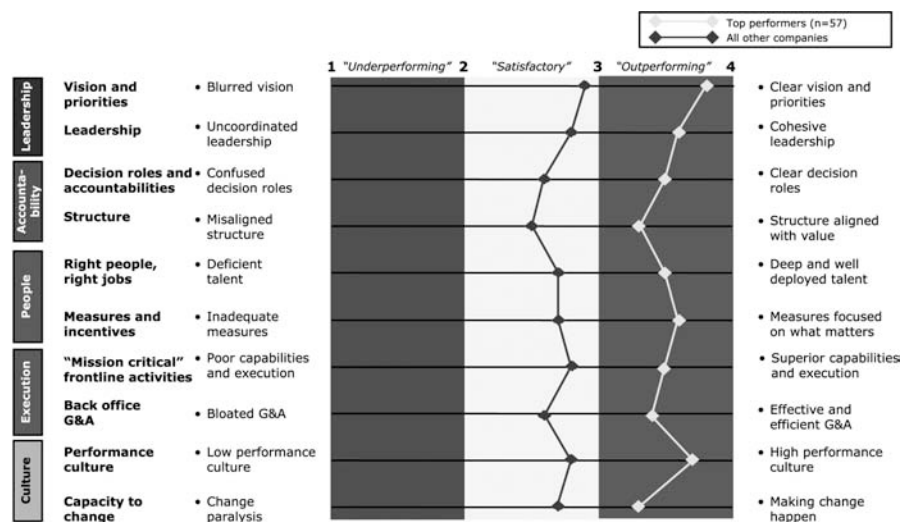
Figure 1. Bain and Company Report on high performance companies

One way to put this in perspective is to see how your projects and initiatives feed back into the overall objectives.   Below is an example of a strategy map for an organization that wanted to develop a metrics

2

program. Here you can see how their mission and vision is directly supported by their metrics strategy all the way down to how they invest their time (projects, initiatives).
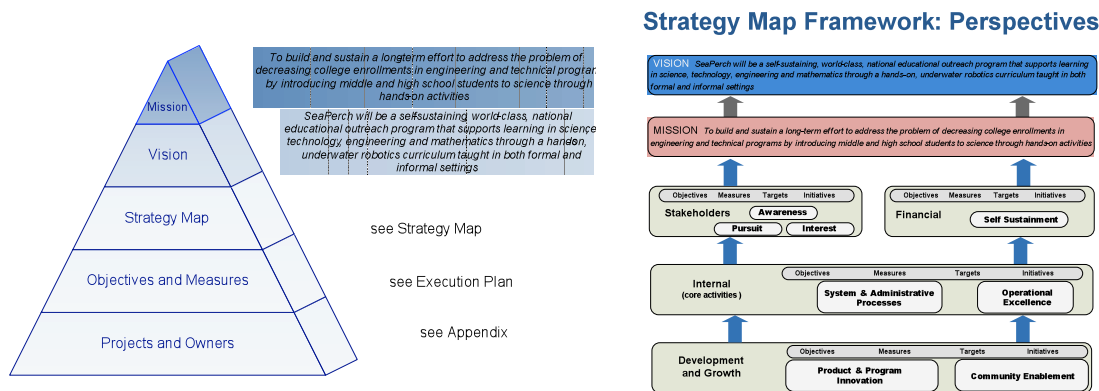

Figure 2. Linking metrics to strategy through Strategy Maps

Dashboards that Communicate

With a strong Business Intelligence solution, companies can support decisions with more than just a gut feeling. Creating a fact-based "decisioning" framework provides confidence and reliability in the decision making process.

One of the components of a "BI" solution is a dashboard. A dashboard is a visualization technique that provides a visual cue as to the status of one or more key performance indicators (KPI). KPIs can be any measure of interest and are visually shown in the dashboard as something interesting and intuitive to your audience. Examples of indicators are thermometers or speedometers as they represent something in the real world that we are familiar with and know instantly how to read and understand what they represent.

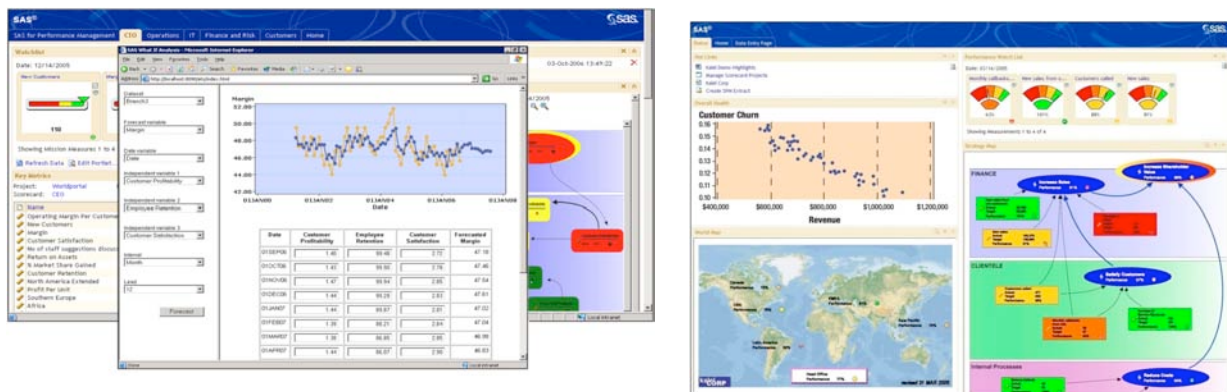Below are some examples of dashboards built on top of SAS.

Figure 3. Example dashboards

SAS and BI

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

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

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.

BI DASHBOARD

The BI Dashboard (the topic of this paper!) is a web-based tool that works with the Information Delivery Portal to display dashboards of Key Performance Indicators (KPIs). The BI Dashboard provides the following features:

- Key Performance Indicator (KPI) data can be obtained from an Information Map, a Stored Process, a SQL query, SAS Strategic performance Management 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

BI Dashboard Overview

The SAS BI Dashboard is a plug-in to the SAS Information Delivery Portal, which is a new feature that was made available in production starting with SAS 9.1.3 SP 4. Assuming that you have this version of SAS Enterprise Business Intelligence and have installed the BI Dashboard, you should be able to run through any of the examples we have outlined in this paper.

At a high level, think of the Information Delivery Portal (known throughout this paper as the IDP) can contain one or more BI Dashboard Portlets. Think of these as different windows into data on the IDP. Within any given BI Dashboard Portlet, you can have one or more Dashboards (available through a drop-down list if you have more than one). Each Dashboard, in turn, has indicators that are simply visual displays that tell a story about something of interest. You can display and modify the settings, image types and links or actions for all metrics displayed in a dashboard. An indicator must be created before a dashboard can be defined. A metric, or key performance indicator (KPI), is a measure or number that we are interested in showing or tracking.

In the SAS BI Dashboard, we have a number of options for indicators that range from sliders to gauges to tables and charts.   The type of indicator that you use is dependent upon the type of data and the story that you want to communicate with the data. In our example, we used a speedometer, as it is a quick-and-dirty way to evaluate the progress towards a goal. In the graphic on the right, note that there is only one indicator shown and typically, a number of indicators would be included together in a dashboard to tell the whole story.
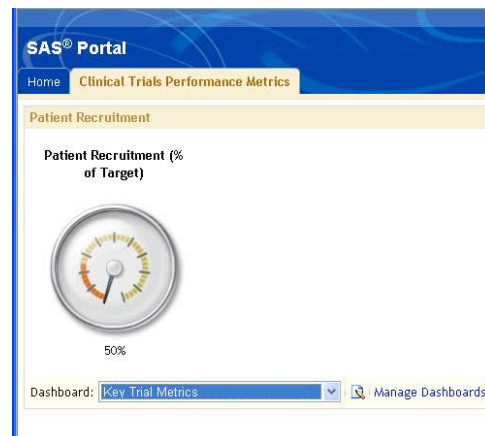
It should be noted that the SAS BI Dashboard is NOT the only way to build a dashboard in SAS. Other options include custom development using SAS/Graph, building java or .Net applications or SAS Strategic

Performance Management (SPM). For a more in-depth look at creating dashboards using these options, we refer you to Jeff Wright's 2008 paper in the reference.

Understanding the Business Need

If you've read any of our previous papers, you will no likely be tired of us standing on the *"understand the business need"* soapbox. So as to not disappoint you, we will share with you our philosophy again!

More often than not, we as technologists forget the reason that we set out to solve the problem. In this case, your task is simply to gain familiarity with a tool – in this case, BI Dashboard. But remember, a solid understanding of the requirements for reporting and analysis is key to being successful. Just because we don't talk about the reports or how we might want to use the data doesn't mean that you should forget those tasks when diving into a new project. One of the ways that we described in the earlier paper (Nelson, 1999) was to learn to ask yourself: what questions do we want to answer of the data?

One of the ways that we do that is by mocking up what our finished dashboard ought to look like. For example, in a previous paper (Nelson, 2008), we outlined a number of measures appropriate for tracking clinical trials success.

Trial Progress/ Timeliness Metrics	Financial Metrics
Investigator recruitment and startup Patient recruitment/ enrollment CRF progress Clinical supply chain visibility Milestones on target/ missed Contract signed on-time Protocol issued on-time FPFV on-time Standards compliance	Earned value Actual to forecast Pipeline Pre-proposal financials Patient recruitment, advertising and incentives Average per-patient costs by trial/ therapeutic area Cycle times and time-based trial milestones Resource allocation-based metrics Efficiency and operations-based measures
Queries/ CRF Resolutions (type I and II) Adverse events Patient satisfaction Physical satisfaction Investigator and Site performance Error rates in CDMS (forced unlock, programming errors, final table re-work,) LPLV to DB Lock DB Lock to final results	Staff performance by site Staff/ contractor retention Timeliness of staff through all phases Programming productivity (level of complexity actual to forecast) Load forecasts for skilled resources Enrollment quotas EDC performance Patients per CRA
Quality Metrics	Resourcing Metrics

Figure 6. Sample KPIs or Metrics for Clinical Trials

In our example here, we are going to use some fictitious data and report patient recruitment numbers for a clinical trial. Once we have the mockup complete, we can then flesh out the requirements for the data. We have taken patient recruitment data (actual versus target) and created an Information Map (using SAS Information Map Studio) that contains the target, actual and a derived variable labeled "Patient Recruitment % to Target".

Building Your First Dashboard

The remainder of this paper outlines the steps that you can go through to build your own dashboard. Before we can do that effectively, we need to data. In our example, we are going to use "out of the box" sample datasets that come with SAS. While this makes is easy for you to run through the samples that we've included here, it clearly wont be as compelling as seeing your own data and own business metrics being displayed. But then again, that's part of the fun of creating your own dashboard beyond the classroom!

Preparing Your Data

BI Dashboard indicators have certain expectations about the data that is presented to them. With any reporting option, you have to have data in order to present data! The SAS BI Dashboard expects it to look a certain way. For example, if you want to show a single number such as percentage to target as a ratio of planned to actual, then you need to make sure that you have that calculation in the data. In our example, we took a dataset that contained metrics by various class variables (location, type of study, clinical phase, etc.) and then created an information map using SAS Information Map Studio. Here, we calculated the percentage and then used that info map as the data model for the indicator.

Each indicator that you see in the SAS BI Dashboard has a certain expectation of the format of the data that underlies it and it is beyond the scope of this paper to explain all the data requirements in detail.

5 Easy Steps to Building Your Dashboard

At a high level, we need to do 5 things (assuming you know how to log on to the IDP!):
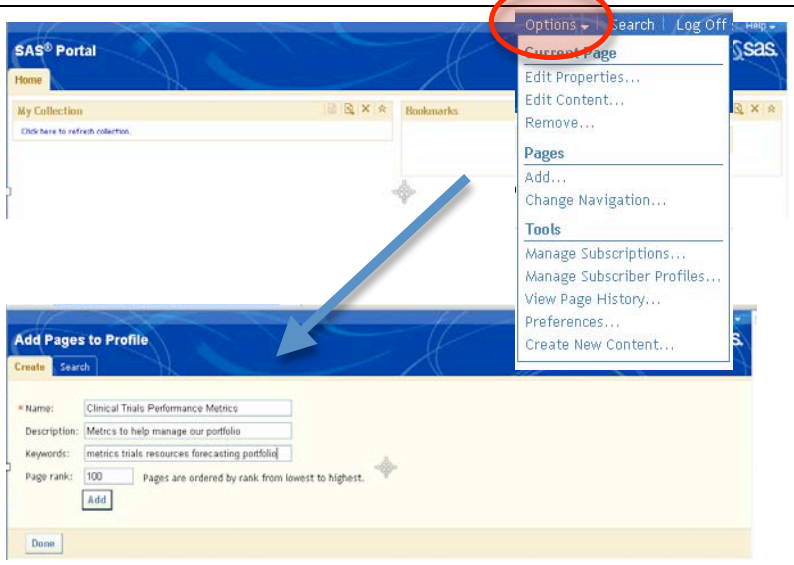
1. Create a new page on the portal

    - Create a new page within IDP

    - Create a new dashboard portlet within that page

    - Set some properties for the portlet

2. Create reference to external data (called Data Models)

    - Define the name and attributes for the metadata (so we can reference our data)

    - Specify the mechanism to return data (InfoMap)

    - Select the fields we want from our data

    - Specify field labels and other options to show on the dashboard for our indicator(s)

3. Define a "range" which is used to traffic light or color code our indicators

    - Create a new range

    - Specify intervals and options for the range

4. Create an indicator on the dashboard

    - Define the indicator

    - Define the links

    - Define the display

    - Configure the indicator

5. Create the dashboard

    - Create a new dashboard and set its properties

    - Add an indicator

    - View your dashboard in the portal!
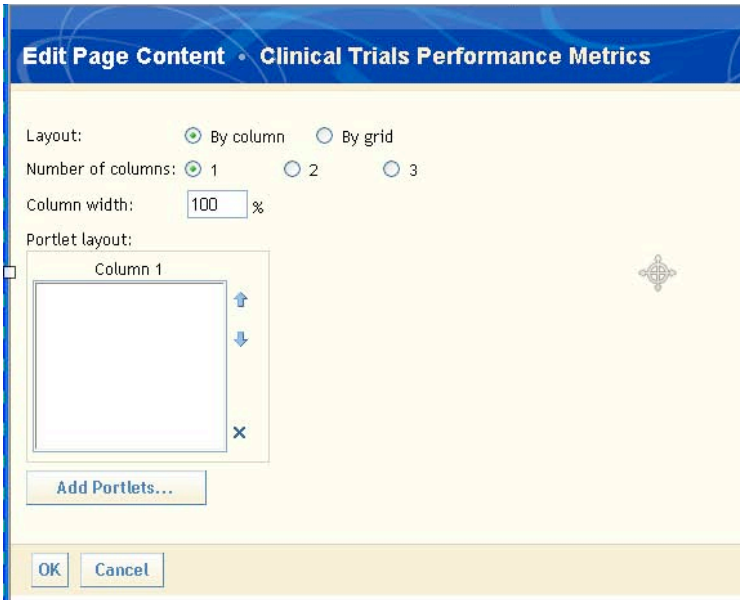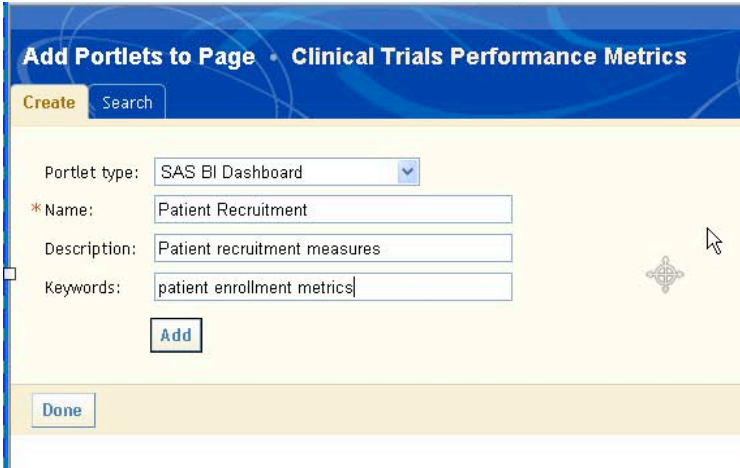
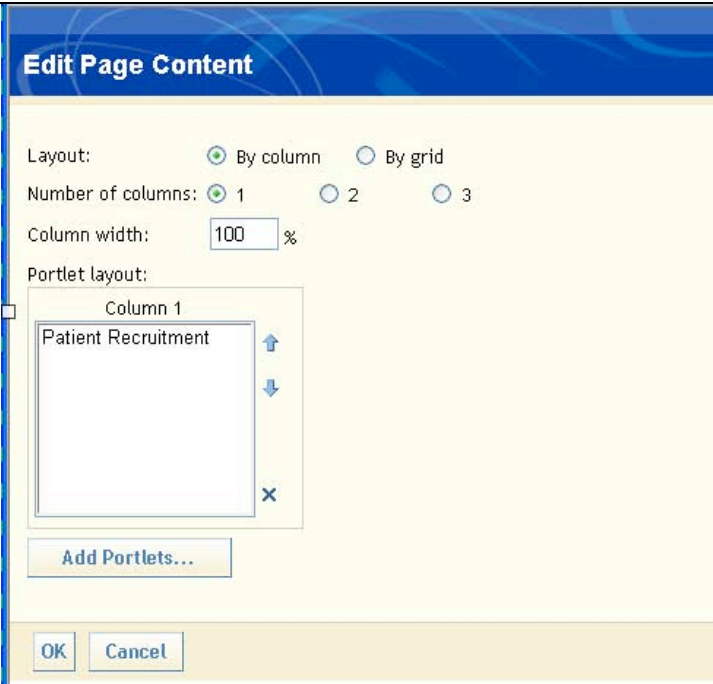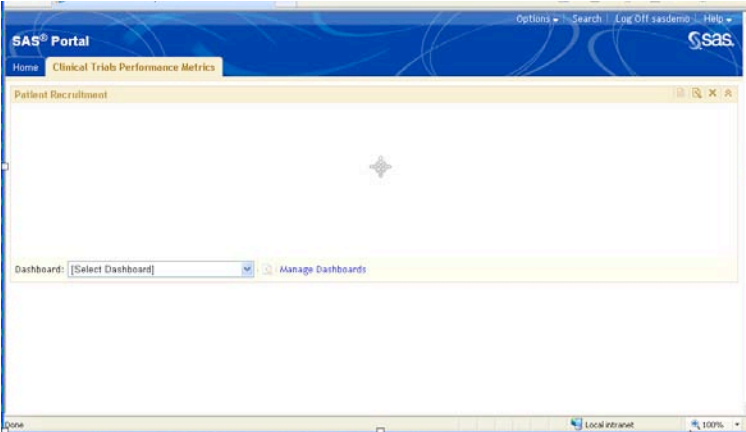*Task #1: Create a new page on the portal*

STEP A: CREATE A NEW PAGE WITHIN IDP

1. Let's start with creating a new page and adding it to your portal navigation:

1st.	From the main portal page, click Options > Add	
2nd	Enter information about your page (useful when finding this page via search)	**Name** A short name that will appear in the page's tab in the navigation bar. **Description** A short description that will appear with the page title in search results. **Keywords** Single words that you or other users can use to search for this page. Use spaces to separate keywords from one another. *Note*: To ensure efficient searching, develop a standard list of keywords and use these keywords consistently. **Page rank** A number that indicates the importance of this page as compared to other pages. The default value is 100. This number determines the order in which pages are listed in the navigation bar. The pages are ordered by rank from lowest to highest. Pages with equal rank are listed in the order in which they were created. *Note*: You can choose to override page ranks by explicitly defining the order of pages. **Location (group) and Share type** These fields appear only if you are a group content administrator. In these fields, you can specify a group with which the page is to be shared and specify the share type.
3rd	Click Add and then Done	Verify that the new page was added.

2. Next, we want to add a SAS BI Dashboard Portlet to the page we just created:
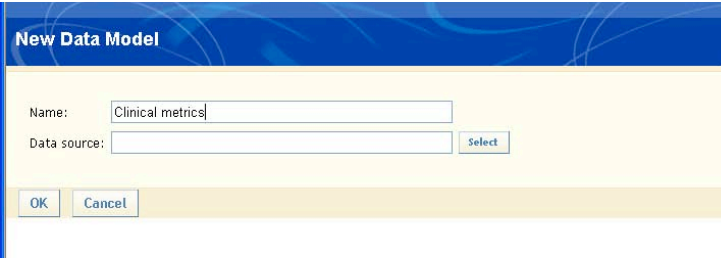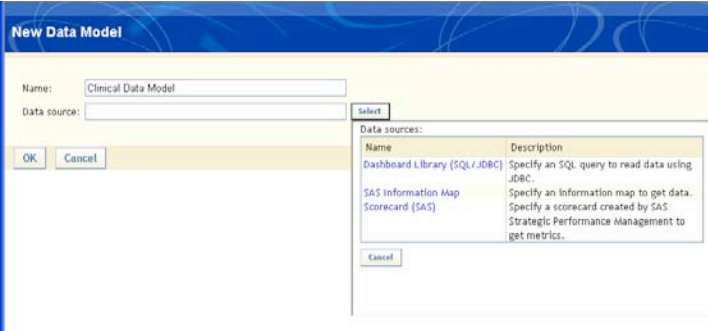
4th.		Navigate to the page where you want to add the portlet.
5th.	Click Options > Edit Content	
6th.	Click Add Portlets	From the Portlet type drop-down list, select SAS BI Dashboard. Type the name for the portlet, and if desired, the description and keywords.
7th.	Modify the Portlet attributes	Click Add, and then Done. On the Edit Page Content page, click OK.
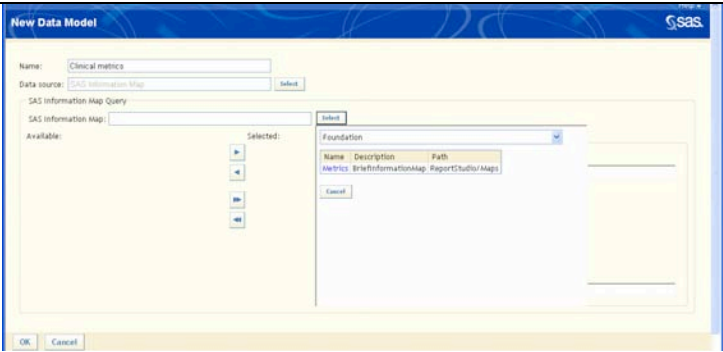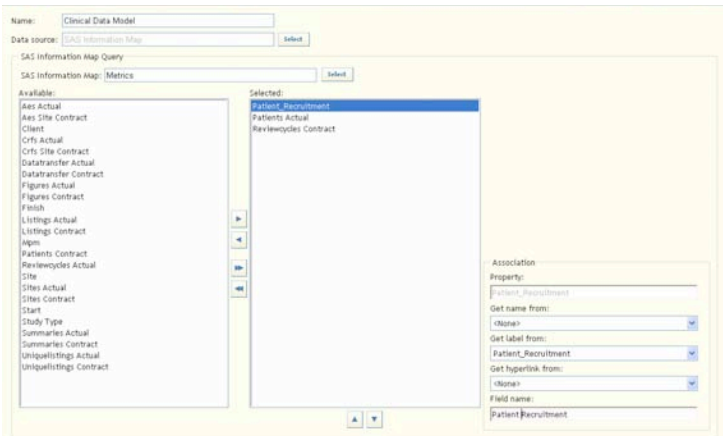
The original page is displayed, with the new portlet added.

Task #2: Create reference to external data (called Data Models)

Your next step is to create a "data model" for your indicator. The data model can use an Information Map, a Stored Process, a SQL query, SAS Strategic performance Management or a custom JDBC data source. For this example we will use an SQL data source.

8th.	Manage Dashboard	In the SAS BI Dashboard portlet, click Manage Dashboards

		The Manage Indicators page appears.
9th.	Manage Data Models	Click Manage Data Models. Click new.
10th.	Define the Data model attributes	Select SAS Information Map. Since we are pointing to an Information Map, we select the Foundation Repository and our Metrics InfoMap (defined in Information Map Studio)

11th.	Specify the Columns we want available in our Data model
We can move table elements out of the selected column if we do not intend to use them in our dashboard. In our case, we only want three columns.

Click OK and Close. |

Task #3: Defining a range for our indicators

Next, we need to define a range. A range allows us to traffic light items so we know when things are good or bad!) We need to create a range for each indicator that we want on our dashboard:

12th.	Manage Ranges	On the Manage Indicators page, click Manage Ranges.

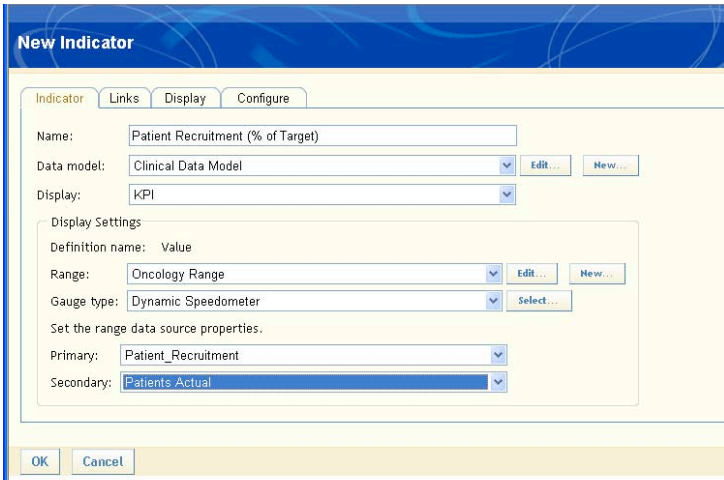|		
		Manage Ranges Rows displayed: 15 Go Range Description No values were returned for this table. New… Close
13th.	Create a New range	**New Range** General Information * Range name: Patient Recruitment Range Description: Acceptable ranges for oncology studies Range Definition Enter an Interval, click Add Interval and the intervals are calculated for you. Interval: Add Interval Code Interval (For static gauges only) Interval Label Color (For dynamic gauges only) Delete Validate Colors with asterisks (*) will not display in dynamic gauges. OK Cancel
14th.	Create our range	For this example, we will create a range with intervals at.50, .60 and .90. Indicating the percent of target for patient recruitment. **Range Properties** General Information * Range name: Oncology Range Description: Acceptable ranges for oncology studies Range Definition Enter an Interval, click Add Interval and the intervals are calculated for you. Interval: Add Interval Code Interval (For static gauges only) Interval Label Color (For dynamic gauges only) Delete Below Target <= .50 Below Target * × Below Target > .50 and <= .6 Below Target × On Target > .6 and <= .9 On Target × Above Target > .9 Above Target * × Validate Colors with asterisks (*) will not display in dynamic gauges. OK Cancel Click OK. You return to the Manage Ranges page. Click Close. You return to the Manage Indicators page. Remain on this page.

13

Task #4: Create a new indicator
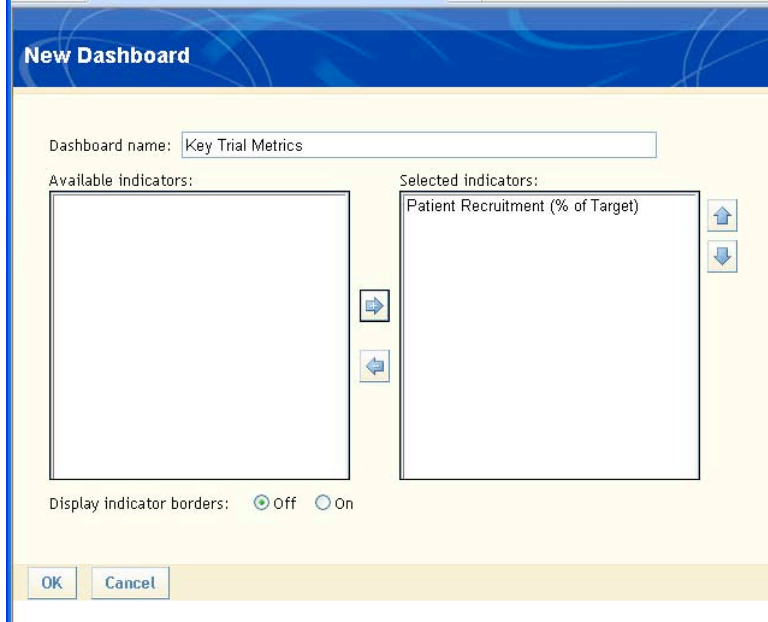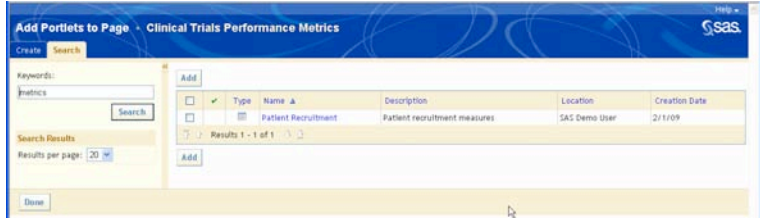
1. Define the indicator:

15th.	Create a new indicator	On the Manage Indicators page, click New Indicator.
16th.	New indicator options	From the Display drop-down list, select KPI. From the Range drop-down list, select Oncology Range. From the Gauge type drop-down list, select Dynamic Speedometer. From the Primary drop-down list, select PATIENT_RECRUITMENT.
17th.	Make final adjustments to the size and other options	For our example, we don't make any other adjustments to the Links (what happens when you click on the Indicator), Display (options for how the indicator is displayed) or whether the user can change any of the options at run-time Click OK.

Task #5: Create the dashboard
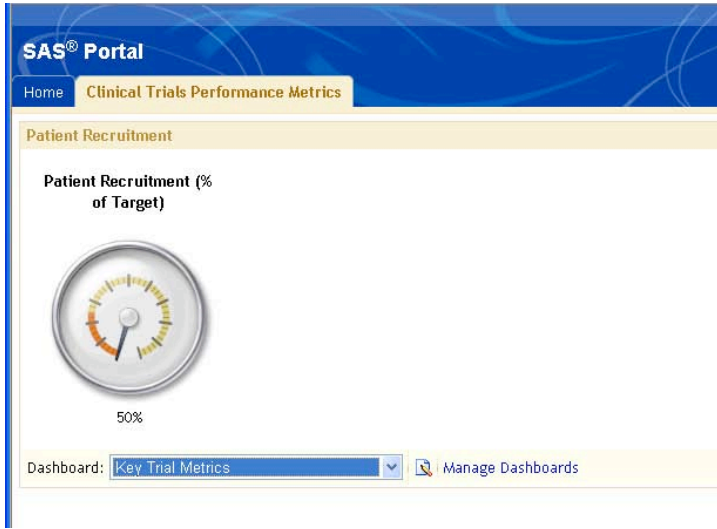
2. Create a new dashboard:

18th.	Manage	On the Manage Indicators page, click the Dashboards tab.

	indicators	The Manage Dashboards page appears.
19th.	New Dashboard	Click New Dashboard. The New Dashboard page appears. Click OK. Next we will add the portlet that we just created to our page. Edit the portal page where we want to add our dashboard.

VIEW YOUR DASHBOARD IN THE PORTAL!

20th.	Go to the main Portal page	At the top of the page click Portal.
21st.		From the Dashboard drop-down list select Key Trial Metrics. And now we see our dashboard complete with a speedometer indicating that our patient recruitment progress is below target!

Next Steps

As you build out your dashboard, there are a number of other things that you will need to consider as you think about whether you are done and ready to share with other users. We assume that you have gathered requirements and are building those requirements into the software. Other things that you might want to consider as extensions to your work here include:

- Create web reports or stored processes for drill down (when a user clicks on an indicator)

- Use IDP portlets to bring in other sources of data to complement BI Dashboards, such as other web applications, documents, and external data sources

- Develop collaborative facilities so users can comment and interact on insights from dashboards

- Work with users to define governance strategies for defining and managing data, stored processes and ranges

16

BI and dashboard development requires iterative development with user community and don't expect your first dashboard to be the final one. Once the dashboard has been deployed, expect it to change and grow in ways that you never expected. After all, once users don't have to spend all of their time finding, combing, understanding and analyzing their data, they can and will spend more time understanding the implications of the data!

Summary

The SAS BI Dashboard is an add-in to the SAS Information Delivery Portal that allows you to connect back-end data and processes to indicators that are displayed in a dashboard format on a web browser. Here, we have described why dashboards are important, what are all of the moving parts and where they live in the SAS Information Delivery Portal.

Perhaps the most complicated part about creating a dashboard is getting the data right. You first have to massage the data into the right format. Then you have to connect this to the indicator through a "data model".   For more information on how all of this works and to understand the mechanics of the technology, we encourage you to take a look at the SAS online documentation highlighted in the reference section.

There is much more than you can do with dashboards such as personalizing your indicators, creating new indicators from technologies like Flash and accessing data from data sources other than pure SQL access to a SAS dataset which we have shown here.

For more information on dashboards, please see some of our other papers in the references section and if you are serious about dashboarding, we strongly suggest that you get Stephen Few's book! Happy dashboarding!

References:

Dresner (1996) Cited in:
http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=266298

Few (2006) "Information Dashboard Design: The Effective Visual Communication of Data" O'Reilly Media, Inc.

Kaplan and Norton (1996) "The Balanced Scorecard: Translating Strategy into Action" Harvard Business School Press

Nelson, G. "Implementing Metrics Management for Improving Clinical Trials Performance" Published article on the B-Eye-Network's BioPharma Channel. July 17, 2008. http://www.b-eye-network.com/channels/1278/view/7981/

SAS Online documentation for the SAS BI Dashboard: http://support.sas.com/documentation/onlinedoc/bidashboard/index.html

Wright, Jeff , "SAS®: The Ultimate Dashboard Machine," Paper presented at the Annual Conference of the SAS Global Users Group, 2008 San Antonio, TX.

Other Relevant Papers by Greg Nelson:

SGF2008 ETL and Data Quality: Which Comes First?

Emilio J. Power Gregory Nelson

Pages: 10 Size: 354 Kb Keywords: Data Quality DataFlux Data Integration Studio ETL

SGF2008 Building OLAP Cubes with SAS® 9: A Hands-on Workshop

Gregory Nelson

Pages: 27 Size: 4809 Kb Keywords: Data warehouse DI Studio OLAP Cube Studio star schema MDDB MDX

SGF2008 Exploiting OLAP Cubes with SAS® 9: A Hands on Workshop

Gregory Nelson

Pages: 13 Size: 861 Kb Keywords: Data warehouse DI Studio OLAP Cube Studio star schema MDDB MDX SAS Add-in for Microsoft Office SAS Information Delivery Portal.

SGF2007 Planning for and Designing a Data Warehouse - A Hands-On Workshop

Gregory S. Nelson

Pages: 16 Size: 158 Kb Keywords: ETL Studio Data Integration Studio BASE SAS SQL data warehousing slowing changing dimensions change data capture transformations ETL warehouse

Download the code (1227 Kb)

SGF2007 Architecting SAS® in a Modern World: Best Practices for Design, Configuration, and Management of SAS®9

Gregory S. Nelson

Pages: 15 Size: 483 Kb Keywords: SAS 9 architecture I/O Citrix VMware operating systems IT support multi-processors

SGF2007 Introduction to SAS®9 Business Intelligence - A Tutorial

Gregory S. Nelson

Pages: 12 Size: 447 Kb Keywords: SAS 9 Business Intelligence Server BI SAS Add-in for Microsoft Office Enterprise Guide Web Report Studio Information Delivery Portal stored processes metadata server

SUGI31 Base SAS® vs. SAS® Data Integration Studio Understanding ETL and the SAS® Tools Used to Support It

Danny Grasse Gregory S. Nelson

Pages: 20 Size: 593 Kb Keywords: ETL Studio BASE SAS SQL data warehousing slowing changing dimensions ETL

SUGI31 A Pragmatic Programmers Introduction to SAS® Data Integration Studio

Gregory S. Nelson

Pages: 34 Size: 1977 Kb Keywords: ETL Studio Data Integration Studio data warehousing change data capture transformations ETL

SUGI22 Implementing a Dimensional Data Warehouse with the SAS System.

Gregory S. Nelson

Pages: 10 Size: 1224 Kb Keywords: warehouse

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 Healthcare and Life Sciences. 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.

Contact information:

Your comments and questions are valued and encouraged. Contact the authors at:

Greg Nelson   greg@thotwave.com

ThotWave Technologies, LLC

510 Meadowmont Village, #192

Chapel Hill, NC 27517 (800) 584 2819

http://www.thotwave.com

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

thinking data® is registered trademark of ThotWave Technologies, LLC.

Other brand and product names are trademarks of their respective companies.