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Flip the Bow Tie: Pushing Business Intelligence to Operational Applications

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The original 'bow-tie' Data Warehouse architecture places Business Intelligence on the right side, with Reports and Decision Support. This presentation will review an architecture that adds Business Intelligence to the left side, in concert with operational systems.

Traditionally, SAS® developers have shied away from the operational side. There are several reasons for this attitude. SAS is thought to be too slow for operational needs. SAS being a high-end statistical and analytical tool doesn't seem to mesh with the data entry needs of operational systems. Even more important, most companies have their operational systems in place and well established, so where's the market?

We have all seen the Data Warehouse Bow Tie. The bow tie graphically depicts the process of extraction, transformation and loading of data, followed by the exploitation of that data to the "Front End" end users. It assumes that all Business Intelligence is focused on supplying information or "Gold" to downstream decision makers. The bow tie also assumes that data can be 'fixed' after it is created. In reality, the data may be patched up or painted over but problems remain and a lot of money has already been expended.

Many companies have realized they need to enhance certain areas in order to survive. One such area is maximizing data and process quality at the operational level. Why the refocus? Past experience has proven that to just make strategic plans is not enough. Business Intelligence systems must also manage the capture, storage and distribution of data in a way that supports company vision. This must include changing the view to show that operational applications are included in the "Front End" of business intelligence applications. Companies want everything they do to reflect a return on investment (ROI). In order to make these critical ROI judgments, they require high quality data. Recently, companies have applied great efforts to build Customer Resource Management (CRM), Risk Management, Data Warehouse and other Decision Support systems. All these applications promise quality analysis but the reality is that they are bound by the primary quality of the data and it's timely availability. Companies struggle to make strategic plans based on ROI projections with the data available. Sometimes their plans fail because the underlying premise was based on poor quality data even after being cleaned by an ETL process. Using business process controls can help insure data quality while also reporting on deviations from the process.

Now we have the business case for SAS high-end statistical procedures, data manipulation capabilities and cross platform access. So what is missing that would keep developers from using SAS? A major component that is missing is process and business rule control. A new third party software call Automated Consultant® can fill in the missing piece by providing object orientated expert system technology in a SAS environment.

So what is so special about this add on? It is still a SAS platform and as such would be slow, right? How would process be managed by SAS? Rule based engines are slow; the more rules the longer it takes to go through them. How would this be different?

First, it should be said that SAS has been able to provide web-based applications for some time. Anyone that has signed up for a SUGI conference via the web knows this. Edits applied to web input can also be handled by various means both within and outside of SAS. The new and exciting part of this technology is the ability to create a SAS object oriented application server that is specific to a business process that only requires Base SAS to run.

A more formal definition from the vendor is that Automated Consultant® is intelligent software that runs in the SAS® environment. Automated Consultant provides object modeling of a business process while at the same time embedding intelligence into the model. The tool applies knowledge management with built-in intelligence to allow organizations to:

- Create templates for business-intelligent front-end systems
- Create expert system agents to monitor business processes
- Insure data quality control
- Standardize processes and procedures
- Convert existing SAS® programs into object-oriented technology
- Extend expert system intelligence into data warehousing

It should be noted that the above description does not mention web-based application server. The reason is that the software is 100% SAS and can run in several modes including batch, behind the web or part of it. The requirements of a given business process drive the execution model.

To better understand how SAS can perform as a web-based application server. This paper will review one case study that completed such a project. The project created a web-based application using business rule driven objects.

The case study is a biotech manufacturing company. They wanted to automate and enhance the cell count manufacturing process while improving data quality.

The plant operators record critical information during the cell culture process. The manufacturing managers wanted to bring the knowledge base of process rules into data entry procedures in a way that would help insure quality. The quality managers wanted access to real-time data as well as historical trends.

Key systems requirements:

- Web-based using standard browsers from client workstations that do not have SAS installed
- Allow for multi-user access
- Support corporate security model
- Provide the creation of complex business rules that can use both historical and active data that are also easy to modify
- Support cross platform access to other data bases such as Oracle® and SM-IP21
- Support high-end SAS reports with graphics
- Access to data in real time, while supporting storage of historical data
- Ability to insert previously created SAS programs into the model as business demands dictated
- Fast access to data and reports
- Application that can run in a SAS/IntrNet or Java based environment without modification

The solution was to create a web-based expert system that provided real-time information to managers and operators. In addition, key process indicators (KPI) in the form of high-end statistical SAS reports and charts were made available to operators and managers in real time across the web interface.

First, a modified project methodology was needed to support not only the capture of system requirements, such as web interfaces, data structures, and transformations but also business process mapping.

Phase One: Design the Knowledge Tree

Automated Consultant's first phase is to create an outline of the business process "This requires building a tree structure based on the object decomposition and showing the temporal, functional, and hierarchical relationships between the objects". [1]

This phase in non-technical and is conducted by the project manager with the client business manager. The goal of the phase is to capture the desired business process that the client wants to manage and goals of the new system.

In the case study, phase one was conducted with both on-site and off site interviews. The client provided a high level understanding of

how the system would be used, access and the high level goals. Next the development team using the Automated Consultant GUI interface created the first draft of the system process tree. Figure 1 shows the first draft for the case study.

Each leaf (node) in the tree identifies an idea or function that is required in the business process. As each node is added that node now becomes part of the business model tree. During first draft, the tendency is to model to a level lower than what is required for functional efficiency. Therefore, the model goes though object decomposition in a way that will bring about efficiency and still be easily understood by non-technical users. Figure 2 shows the resulting decomposition.

Phase 2: Design the Objects

"Objects are programming constructs containing data in 'attributes' and labeled blocks of program code in 'methods.' " [2]

The concept now switches from outline to definition of methods and procedures.

Once the tree outline was completed the next phase was to define each object within a node and the methods that will act upon the data. In the case study, data was presented, using HTML forms, to an object within the tree, which identifies the method and performs the defined actions. Depending on the scope of the method, data may be transformed, loaded, used for reporting and so on. In each case the results are specific to the methods in the object involved. However, it should be noted that within the tree results are shared or inherited. What this means in the SAS world is that specific blocks of code can be executed without involving other blocks of code. The ability for direct execution is a major benefit of Automated Consultant. In a web environment, this can result in improved speed of information delivery since only the code needed for a specific action or request is executed.

Phase 2 empowers the non-technical users to come up with "Pseudocode". Pseudocode is the laypersons definition of just what the object should do. Automated Consultant provides the ability to document this Pseudocode into a stored method that becomes a record of the development process. The first two phases using Automated Consultant can be and should be conducted without trying to design how the system would be implemented. This is just good modeling practice and supports SAS's flexibility in the design phase.

Phase 3: Design the Methods

"This is where the programmers take the design lead and develop the Base SAS code implementing the methods". [3]

Technical developers use the information provided in Phase 2 to design the methods in this phase. It should be stated here that this is the first point that "coders" are required.

The reality is that for any given project more than just base SAS may be required. In the case study, complex SAS STAT and SAS ETS code was developed. Business rules were applied using base SAS. SAS to ODBC, Java Script and SAS/IntrNet interfaces to new proprietary data sources were also defined. All in a days work for SAS.

Designing methods:

For each method SAS programmers apply code that defines just what is required when a leaf (node) in the tree is executed. What is more important here is that a method can define and execute different rules within a node. Any data variable or groups of variables can be the key to a methods execution. Those that do not apply are bypassed. AC allows both process and timing to be part of the same design within the same tree.

In Automated Consultant "XOMETHOD" and "ENDXOMETHOD" creates a wrapper for SAS code to be executed from the program "AGENDA". SAS code can be anything from base SAS, SAS SQL, Macros, SCL and so on that SAS supports.

The program agenda drives what is going on in the application. In Automated Consultant the

agenda can be modified from within a method. This means that developers can completely control the program execution stack, branching execution of objects down, sideways, or upwards within a tree. Controlling the agenda also allows for execution of specific branches and execution of other knowledge base trees. From within a method even other knowledge base catalogs can be called extending the possibilities of business management with embedded intelligence to a repeatable and extendable effort.

Implementation

To support the business model the knowledge base tree contained the functions of data input, rule base feedback and key process reporting.

To access the tree operators sign on to a SAS/IntrNet logon page for userid and password verification. Once a successful logon is granted, a SAS session is started calling the SAS catalog that contains the knowledge base and Automated Consultant. AC will process the first request by setting all environment global, macros and agenda stack. AC then builds the main entry screen html and control is passed back to the web server. AC then waits for the next request. Depending on the operators selection a new file will be sent to Automated Consultant which processes the form data and sets the agenda to the method that should be next in execution. This back and forth process will continue until the operator logs off or the system times out.

During the session, Automated Consultant's "Black Board data base" logs requests, results and other information so that other objects within the tree inherit the information. Since this memory resident database is a SAS dataset it can be become a historical record of the session transaction.

Conclusion

The SAS system can be used for operational business intelligence using normal SAS code and software. Combining existing SAS capabilities with Automated Consultant results in a clean, extensible and flexible system. AC enhances the project development process by providing structure and graphical interfaces that make the business process easy to understand for non-technical users. Automated Consultant provides the execution process control that SAS program code cannot easily manage.

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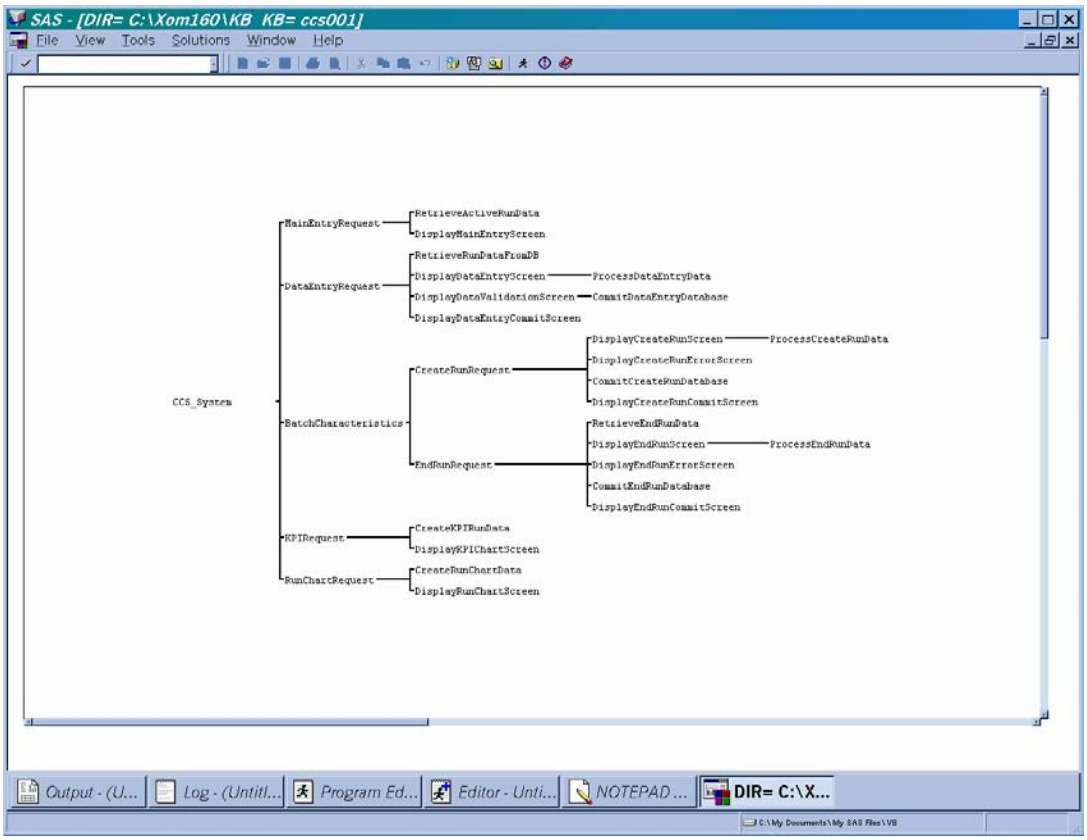

Figure 1 First Cut of Outline

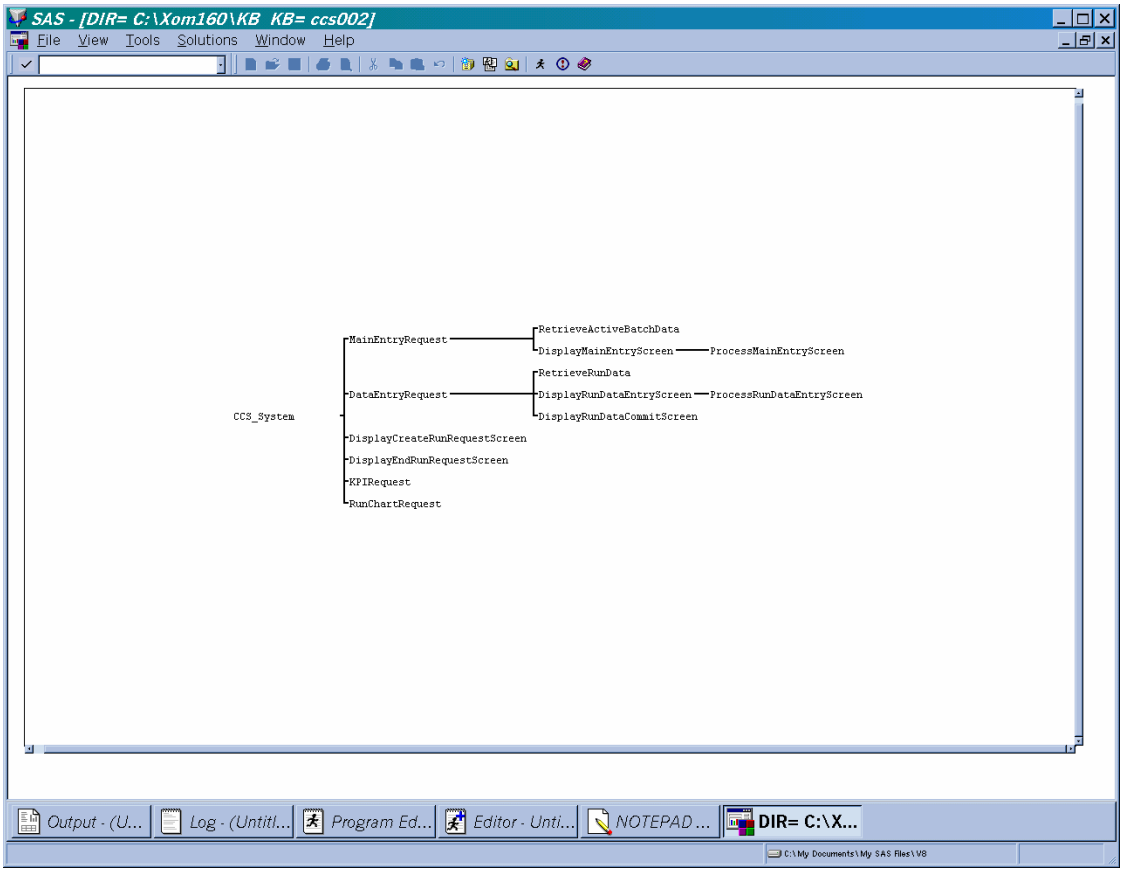

Figure 1 Decomposition of Tree