

Beyond the Printed Page

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ABSTRACT

In the 60's and 70's our computer systems were developed to the point that they could generate reams of printed reports at the whim of the operator. With the current exponential growth rate of available information, we will soon be buried in paper unless we develop other means of information delivery. This paper addresses alternatives to the printed page that are available through the SAS system and currently available output systems. Consideration will be given to: the level of detail to be reported; whether qualitative evaluations are to be presented; the actual information delivery system; the speed at which a decision can be made and communicated to the persons that can implement the desired action. A general overview of the concept of paperless knowledge transfer will be presented. A case study of a hypothetical company will then be developed that requires timely information transfer to and from the field sale a force and executive management decision support tools driven from a common data warehouse.

INTRODUCTION

This paper provides an overview of some of the alternatives to printed reports and graphs. As the volume of available information continues to increase exponentially, we can become overwhelmed and our cognitive powers begin to shut down. If information isn't delivered in a manner that gets the message to the decision making part of the brain, our efforts are wasted.

OUR TEST COMPANY, GIZMOS 'R US

Gizmos 'R US is a small but rapidly growing toy company that began by manufacturing a flavored teething ring for infants. The company rapidly grew and has gone from a one product, one production line, one retail outlet operation to many products, multiple production locations, and an inhouse/independent sales force.

A flat management structure has evolved with very few management levels and only three people making the company wide management decisions. The CEO is responsible for long range planning and ultimate profitability to the investors. The Director of Operations is responsible for all phases of product production including shipment from the manufacturing location. The Director of Sales and Marketing is responsible for; the storing and

distribution of the finished product, pricing and promotional advertising, staffing and compensation of the sales force, and customer relations. Positions below these levels are staff and first level management positions with minimal summary report requirements.

KNOW YOUR AUDIENCE

Consideration must be given to the viewer's educational and technical background but I feel that it is even more important to try and determine *how much time* the viewer has to spend getting your message. As Gizmos 'R US has rapidly grown, the decision makers are more removed from the final customers and become more dependent on summary reports. The same is true as companies merge and downsize, less and less time is available to decision makers to spend on individual agenda items. Try and find out how much time the viewers are *willing* to spend reviewing your report.

IT'S NOT WHAT YOU THINK, IT'S WHAT YOU FEEL

After you determine the audience, it's time to look at how the viewer will actually use the information. First, the information is designed to help the user to make an informed decision. This data is not being presented for entertainment nor does it appeal to everyone. It is designed to aid decision-makers to quickly and accurately do their job of evaluating and acting. We spend much of our time insuring the accuracy of data but relatively little in the actual design of the presentation of the data. The job of the support staff in the presentation of data is to certify its accuracy and develop an information delivery method that empowers the decision maker with the tools they require. The final decision should be made on how the highest level report *feels* to the decision-maker. The report will **feel** like further action is required. The decision-maker will **decide** to take further action and will **act** to spawn another task. To accomplish the new task, the decision-maker will **delegate** the spawned task to their staff. After the task is finished, a summary report will be made and the decision-maker will **review** this report. They will then **feel** that further action is or is not required. If action is required, run the loop again, if not, move on to the next decision opportunity. This looks very much like a closed loop control system from my days long ago in engineering but it has an added element, feeling. Control systems decide on

a predetermined set of variables, in contrast, these decisions are based on the subjective human quality of feelings.

THE AUTOMOBILE DRIVER AS A DECISION-MAKER

Before we look at the whole report generation structure in GIZMOS 'R US, let's look at the much simpler decision loop involved with driving a car down the road. Assume that we have managed to get the car started, out of the driveway, and are now motoring down the freeway. We look around at the surrounding traffic – we seem to be maintaining the same relative spacing from them and from the edges of the lane. We hear the sounds of the car – sounds about the same as it did a few seconds ago. We physically sense the road surface – about the same number of potholes and dips as a few seconds ago. Everything **feels** fine. Time to go to the next task, how do I feel about the song playing on the radio? Since our primary task at the moment is to drive the car to our destination, we will quite frequently review the input from our senses looking for a change that may require action. When we first began driving, this how do I feel question took almost all of our time to answer. As we became more experienced, we summarized the data and reduced it to a picture or sound that we could very quickly determine a feeling about. Once the *very quickly* level was achieved, we could possibly turn on the radio and add that new level of task into the mix of things. Have we actually evaluated a number yet? No.

Now things change. Our first sensation is that something **feels** different. We very quickly compare our current visual image of the vehicles in front of us to the same scene that was stored in our memory a few seconds ago. We note that the difference is that the vehicle immediately in front of us has taillights glowing bright red is closer. We decide to act and apply the brakes assigning the task of actually slowing to the vehicle's braking system. We review the outcome of this task by observing that the distance between vehicles is increasing, life is good – continue this task of braking until it feels that an adequate interval has been reestablished. Now what happens if the interval doesn't seem to be increasing? We first increase pressure on the brake pedal and if that doesn't achieve the desired results, we may veer off the road and slow down as we drive in the ditch until we stop. After a series of ever changing visual images and sounds, all is quiet and the vehicle has stopped – we feel and this is good. Have we actually evaluated a number yet? No.

Since the brakes didn't seem to operate as we had hoped, we create a new task of finding out what is wrong with the brakes and delegate it to a mechanic. The mechanic drives the car and applies the brakes,

they don't **feel** like they're performing properly. Up goes the car on the lift and off come the wheels. By visually inspecting the brake assemblies, the disc brake pads on the front wheels appear to be worn beyond normal service limits. Have we actually evaluated a number yet? No.

The mechanic might actually measure the brake pad thickness and then refer to the manufacturer's service manual to find the recommended service limits. The numeric value of the thickness would then be compared to the limits and the decision made about pad replacement. More than likely the mechanic would just replace the pads based on the visual evaluation of their condition. Have we actually evaluated a number yet? Possibly...

The above scenario that almost completely revolved around our feelings about physical qualities or sensations is the rule rather than the exception in our decision making process. If at all possible we need to present data in a similar visual manner. Information about data can be quickly conveyed with a pie chart, bubble plot or a simple line plot quickly conveys information without requiring the evaluation of numbers.

AN OPPORTUNITY FOR CHANGE

A major problem with graphical output from mainframe computer systems was the inherent limitations in the output devices, they were designed to produce character rather than graphic output. If graphics could be generated at all, a high penalty had to be paid in terms of file size and printing speed.

Recent years have brought major increases in the computing power and data storage capacities of desktop computer workstations and servers. This increased power coupled with standardized protocols for electronic transfer of data between mainframes and desktop workstations has made it possible to divide the generation of business decision information into phases. The collection of data from legacy production systems and the initial summarization levels can continue to be done on mainframe systems if warranted by the size of the datasets and cost of conversion. Analysis of the summarized data and subsequent reporting can be moved to a workstation on LAN based system with its richer set of output devices, lower purchase and operating cost, and more user friendly interface. SAS/CONNECT® is the primary product in the SAS operating environment to transfer data between operating systems. By using this product, the tasks can be divided between the available operating systems to produce the most cost effective and efficient solution.

Along with the increased use of desktop computers in the workplace, a tremendous increase has occurred in the number of desktop computers in the home and among students. Two of the main applications of these machines are electronic mail and access to the Internet. Most of the decision makers in corporations are, or are rapidly becoming, comfortable with email and Internet browsing. These skills can be leveraged to construct a more efficient system for delivery of decision making information.

PUSH, PULL, SECURITY AND COST

Two basic techniques for information delivery exist on the Internet. Information is *pushed* to the user by sending email directly to them. Or, the user *pulls* information posted on a website by accessing the particular page at the site. In many cases a combination of the two methods is the best solution. A brief email is sent to the decision maker notifying them that a predefined threshold has been reached -- 'Parts rejection rate from Plant B has exceeded three percent.' Included in the email is the hypertext link to additional information on a website. By doing bullet point notification of action items, you have enabled the decision maker to quickly review and prioritize this portion of their work. The website will not normally be an Internet website that is accessible by the general public. Instead, it will be located on an Intranet. An intranet is a company's private version of the Internet. Browsing and email work in the same manner as on the Internet but there is no direct link to the public Internet thereby supplying a layer of security to prevent access by unauthorized personnel. Many corporations currently have or are building intranets. The style and format of the information that we are surfacing for our decision makers can be tailored to be consistent with the overall style of the website. The integration issues can be addressed with the webmaster (the person responsible for the technical content of the website) as well as any requirements for limiting access to parts of the information to specific individuals and/or specific workstations. The task of keeping sensitive corporate data confidential and yet available to authorized individuals is a major issue and will not be addressed in this paper. By referring the security concerns to the webmaster and the IS management, the solution will be consistent with corporate policies and procedures. Another issue is the cost of a private intranet when a corporation has multiple geographically separated operational centers. One of the major costs in constructing a Wide Area Network is the cost of the high speed serial data connections between the Local Area Networks at each of the geographical locations. If this available bandwidth between the operational centers can be used for other services such as voice telephone, video conferencing, or data collection, the net cost to the project can be substantially reduced. A third

option to the Internet and intranet is the Virtual Private Network. This hybrid uses the Internet for the routing and transportation of data but adds an additional layer between the actual data and the network. The layer is encryption of all the data between the data server (the computer that actually contains the data) and the end user. Solutions to the construction of a Virtual Private Network are now available that make their operation completely transparent from the user's standpoint while still allowing the webmaster to completely control access. The area of VPNs is developing quite rapidly and an overview of the current offerings will be included when this paper is presented at the conference.

ORGANIZING INFORMATION ON THE WEBSITE

By its very nature, decision making data consists of layers of more and more highly summarized data. These data are compared to predetermined criteria and the presentation graphic flagged based on the results. A pyramid structure results with each level branching to a lower hierarchical level. Since this structure can become quite large, it generally is more efficient to graft the structure to the corporate intranet by a single *hypertext link*. A hypertext link is the equivalent to a bookmark on an intranet. It allows the viewer to branch to a different page by double clicking on the displayed text. This moves the responsibility for all internal addressing of pages in this decision support system to the system designers. The operation of the web server and overall system security issues remain with the webmaster. Another consideration is that the server that actually contains this decision support data does not have to be the same physical machine as the web server. By using a hypertext link for access to the system, it may be funded, constructed, and operated independently from the corporate intranet server and yet appear to the user as being fully integrated.

When the user initially branches into the decision support system from the corporate intranet, they are greeted with a general menu and possibly some very high level indicators:

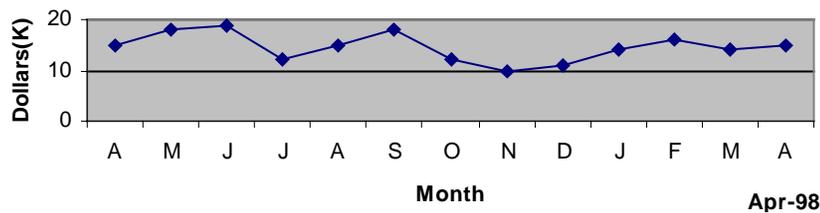
- Up/Down arrow and percent change for total production vs. three month average.
- Up/Down arrow and percent change for total sales vs. three month average
- Current price of corporate common shares and change compared to prior days closing.
- Dow Jones Index shares and change compared to prior days closing.
- Hypertext link to Production reporting section
- Hypertext link to Sales reporting section.

Some standard icons will be available on all screens

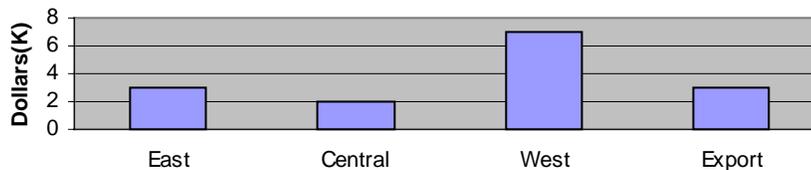
in the decision support system [dss] to help with site navigation.

- Main Menu Returns viewer to entry screen into the dss.
- Site Map Displays entire structure of dss and allows users to branch directly to particular pages without navigating the hierarchical structure.
- Up Level Go up one level in current hierarchy.
- Notify Open a new email composition window that includes a hyperlink to the current page.
- Comment Posts a comment that is associated with the current page and is viewable by everyone.

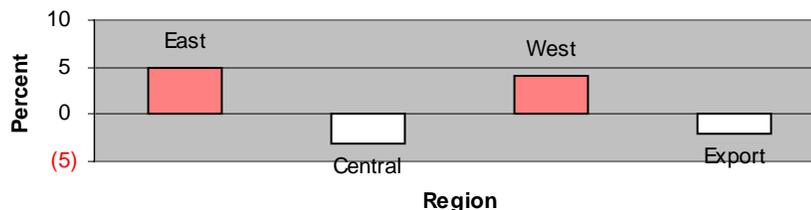
Total Sales for Year



Current Month Sales



Current Month Sales Change vs 3 Mo. Avg.



THE DISPLAYED GRAPHICS

The graphics shown above would be typical of a sales report. The top graph shows a thirteen month rolling window of monthly sales. The viewer can quickly see if sales are up or down for the current month and if the variation could be expected from the prior year's sales. The second graph shows the sales from the four regions that combine to produce the total sales for the month. The third graph shows how much sales have changed for each region as compared to their prior three month average. This basic model is repeated for each level as the viewer drills down to lower levels in the hierarchy. Drilldown is achieved by double clicking on the sales or sales

change chart bar for the desired region. If the East region was selected, the sales for the year in that region would be shown as well as the territories contained within the region and their sales change compared to the three month average. The manufacturing side of the company would see a similar set of reports but instead of geographic sales information, output from the different manufacturing plants would be detailed. Other factors such as cost of raw material, labor costs, defect rate, average time from manufacture to time of sale, sample costs, advertising costs, indirect costs, etc. can be viewed in a similar manner. The number of available reports is basically limited by the storage space on the file

server. The output pages are stored in pdf format and are less than 20Kb each. This small size allows for rapid response to data requests from the users and also allows a large number of these pages to be stored on the server in a nominal amount of space.

DETAILED ANALYSIS AND ADHOC QUERIES

Another type of data reporting is used for the more detailed investigating of the summary data. The system described in this paper is designed to provide high level information in a quickly understood graphical format for use in decision making. If it is decided that a problem does exist it will generally be referred to a support staff member for further investigation. The static reports contained in this system may answer part of the questions but more than likely, more detailed information will be required. One of the finest tools available for this type analysis is the SAS Multi-Dimensional Database Viewer®. This tool provides a row by column display that can have multiple variables on both dimensions in a manner similar to the SAS Tabulate Procedure®. The advantage over the tabulate output is that the structure can be drilled into by double clicking on either a row or column dimension. The other standard analytical tools can also be applied to the data to answer the question.

CONCLUSION

This paper has provided an overview into the philosophy of information delivery through graphics rather than tabular listings. Also described was a basic report structure that provides easy access to all of the decision making information but does not require the printing of volumes of listings and reports. This change to on-line review of reports and printing to hardcopy only on demand from the end user will significantly decrease the consumption of paper. The storage and disposal problems associated with the huge monthly report listings that were automatically printed and distributed from legacy mainframe systems of the past will also be eliminated.

Version 7 of the SAS System brings with it many enhancements in the areas of the delivery of output from both graphical and numeric procedures. I plan to provide a supplement to this paper that will describe how some of the new features will make SAS an even better tool to use to move beyond the printed page.

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FURTHER READING

Tufte, Edward R. (1983), *The Visual Display of Quantitative Information*, Cheshire, CN: Graphic Press

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