Supply Chain Performance Improvement Through Forecasting

by

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Submitted to the Sloan School of Management and the Department of Electrical Engineering and Computer Science in partial fulfillment of the requirements for the degrees of

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ABSTRACT

The digital imaging industry has seen unprecedented growth in recent years. Without a clear leader, competition within this brand new industry is fierce as every company tries to achieve the first position advantage. In order for a company to successfully compete in this arena, effective supply chain management is one of the most crucial leverage points.

The Digital and Applied Imaging Division at Eastman Kodak Company has greatly improved its supply chain performance in the past year by converting from a push system to a pull system. However, due to long lead-time parts, a pure pull system requires an unreasonable amount of inventory. Hence, for production planning purposes, the Digital and Applied Imaging Division relies heavily on demand forecasts.

This thesis first describes the supply chain for the Digital and Applied Imaging Division at Kodak. Next, current forecasting practices are analyzed and critiqued. Two major categories of forecasting methods, subjective forecasting methods, and objective forecasting methods, each with several different techniques, are analyzed.

Based on the analysis, a web-based forecasting data collection tool was designed and implemented to improve forecasting accuracy. Currently, there are roughly 20 users for the tool. The forecast accuracy tracking and measurement for the tool, which will be tied to the account managers' incentive system, is developed for immediate implementation after the data collection portion has been completed.

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My work is done, why wait?
-- Suicide note of Kodak founder George Eastman

1.1 Background

1.1.1 Eastman Kodak Company

Founded in 1888, Eastman Kodak Company in Rochester, NY, is one of the world's leading companies in the consumer and commercial imaging industry. For the past 100 years, the company has been the leader in the traditional imaging industry, producing analog, film-based related products.

With recent changes in the imaging industry because of the digital technology revolution, Kodak is set to become a leading participant in infoimaging, a $225 billion industry[1] created by the convergence of images and information technology which unites three closely related imaging markets – devices (digital capture and scan), infrastructure (convert, transfer, and store), and services / media (share, output, and display).

Although no single company offers a complete range of products and services within each category of the infoimaging industry, Kodak is in a unique position to be involved in all three categories.

1.1.2 Traditional Imaging

When George Eastman committed suicide in 1932, he felt that his work was done and he had nothing else left to achieve. While it may have sounded like an outrageous claim, he was not far from it. Since the 1880s, Eastman Kodak Company had been the leader in the traditional imaging industry. Kodak controlled a long and highly integrated value chain, including the film, the paper, the chemicals, the chemical processing, and even the camera. (Kodak was actually the leader in camera hardware until the 35 mm cameras started to gain popularity in the 1960s.) George Eastman had not only invented a brand new industry, but was also able to maintain near-monopolistic control over it. Being the dominant player in the market, Kodak was able to generate enormous profits no matter what it did.

For Kodak today, traditional imaging is a stable and mature business that generates profits. The market has only two major players, Fuji and Kodak, with Kodak being the worldwide leader. Life cycles for traditional imaging products are typically very long, usually more than two years. The demand variation is usually stable with a predictable pattern based on historical data.

[1] Eastman Kodak Company Annual Report 2001

The supply chain within Kodak for the traditional imaging business is very vertically integrated. Initially, Kodak produced photographic chemicals and other related components in-house because of the lack of reliable and quality suppliers. While it started out because Kodak "had to," the attitude was changed later into Kodak "wants to" produce everything, including chemicals, plastics, metals, optics, etc.[2] Kodak may not be the most vertically integrated plant in the world (that title might perhaps go to a place like Honeywell International's AutoLite division, where it buys dirt and sells spark plugs!), it is very much vertically integrated. Today, even the tape that attaches the film to the spool is manufactured in-house!

1.1.3 Digital Imaging

With recent changes in the imaging industry because of the digital technology revolution, the competitive environment looks much different for the digital imaging business at Kodak. The Digital and Applied Imaging (D&AI) Division at Kodak was created for the emerging digital imaging market. The division's main products include digital cameras, inkjet media, and CD-Rs.

Compared to the traditional imaging business, digital imaging is a new and rapidly growing business. The market is crowded with many competitors, such as HP, Sony, Olympus, Canon, Nikon, etc., without a clear leader. Product life cycle is relatively short, typically ranging from 6 to 12 months. Digital cameras contain long lead-time parts, taking up to 16-21 weeks for some components. While the present goal for the traditional imaging business is profit generation, market penetration and the acquisition of new customers are the focus of the digital imaging business. Demand is also perishable because of the fierce competition and no brand loyalty, unlike that of the traditional film market. Additionally, this is a new, growing market segment where there is not much history to rely upon for modeling, especially with the short product life cycle.

The supply chain for digital cameras is hence very different from that of Kodak traditional products, such as silver halide film and paper. It is very horizontally integrated. Most Kodak consumer digital cameras are manufactured in the Far East by subcontractors. On higher, value-added models, Kodak follows the "direct-ship" model, shipping cameras from the Far East to retailers directly via Federal Express. For the rest, they are shipped (either by air or ocean) to the packaging centers in the US and then distributed through the distribution channels.

The future trend of the digital imaging industry is moving toward the service sector. With the purchase of Ofoto and the "You've Got Pictures!" campaign with America Online (both are online photography services that allows users of digital and traditional cameras to share, store, and develop pictures), Kodak is moving aggressively toward its goal of becoming the leader of the infoimaging industry.

[2] Fine, Charles H. "Clockspeed – Winning Industry Control in the Age of Temporary Advantage," (1998). 33-37.

1.2 Objectives

In today's competitive business environment, especially for an emerging industry such as the infoimaging industry, companies are constantly faced with the challenges of minimizing their operating costs while maximizing overall efficiencies and profits.

Faced with the unique challenges found within the digital imaging business, Kodak has greatly improved its digital camera supply chain performance in the past year by converting from a push system to a pull system. While it was a great leap in the right direction toward supply chain performance, there are still many opportunities for improvement.

The objectives of my research project within the Digital & Applied Imaging Division at Kodak, during the summer and fall of 2001, were to:

- Study and analyze the current digital camera supply chain within Kodak.
- Identify opportunities for improvement.
- Propose a realistic solution.
- Implement the solution.
- Achieve measurable impacts on the D&AI Division at Kodak.

1.3 Approach

Compared to the academic research projects I have conducted in the past, the six months I spent at Kodak provided a completely different kind of challenge. Instead of the usual science or engineering research, I found myself immersed in an unfamiliar business setting, trying to discover and ultimately implement change.

I decided to approach the project by loosely following the Sloan Leadership Model (SLM). I felt that the Sloan Leadership Model was appropriate because the main challenge for the project was not its technical aspect, but rather, the change and implementation aspect. The project was also an ongoing process and I wanted to make sure that it would have a lasting impact to the organization.

Here are the basic steps taken toward achieving the impacts:

- Discovering the Organization
  - Try to understand the situation, environment, and culture by attending important meetings.
  - Identify key individuals relevant to the research project.
- Developing Relationships
  - Set up meetings to interview key individuals.
  - Constant contacts through weekly and monthly meetings.
- Identify Opportunities
  - Study and understand the Sales & Operations Planning process used by D&AI.

- Gather information on ongoing and planned improvement processes.
- Identify the improvement that will achieve the most impact to be carried out for the internship.

- Small Experiments
  - Gather data to determine the requirement for initial pilot test.
  - Create prototype tool to gauge interest.
  - Collect feedback from test users.
- Creating a Vision
  - Create a vision for the solution – in this case, a web-based tool that is accessible by users anywhere with proper Internet / Kodak Intranet access.
- Innovation and Change
  - Define tool functional requirements.
  - Present business case to management to justify using a professional programmer.
  - Propose implementation time line to upper management.
  - Break down the implementation into two separate phases because of resource constraints.
  - Execute implementation.
- Refining and Learning
  - Receive feedback from actual users to further improve the effectiveness of the tool.
  - Evaluate accomplishments and problems.

Between each step is continuous feedback and adjustments to further improve the process.

1.4 Outcome

1.4.1 Need For Demand Forecast

Because of the long lead-time components for digital cameras, a pure pull system from component purchase to camera build would not be able to meet customer demand unless a very large quantity of safety stock is kept. This is why D&AI relies heavily on the demand forecast for production planning.

1.4.2 Standardized Tool

Currently, the demand forecast numbers are, for the most part, financially driven. Account managers develop forecast numbers in terms of revenue, and sales managers compare the forecasts with the quotas driven by corporate financial goals. To the account manager, if the forecast was not up to the quota, his or her sales manager would either find ways to distribute the quota among other account managers, or ask the account manager to re-estimate the forecast in order to make the corporate financial goal. There is no standardized way of communicating between the account managers and the sales managers. Tools used range from e-mail with a revenue number to an extensive Excel spreadsheet, broken down by each SKU (Stock Keeping Unit) number. A standardized tool for communicating information is critical.

1.4.3 Internet – The Way To Share Information

The Internet provides new ways of sharing information within a supply chain. Before the Internet, the traditional way of managing the supply chain was through phones, faxes and the EDI (Electronic Data Interchange) between manufacturers and their trading partners. The Internet has revolutionized how supply chain integration can be done effectively. It has also quickly become the dominant platform for e-supply chain implementation.

1.4.4 Web-Based Forecasting Data Collection Tool

The combination of the need for demand forecasts, standardized tools, and the possibility of Internet technology has led to the creation of a web-based forecasting data collection tool. The resulting tool allows account managers to communicate forecast numbers to a centralized database via a familiar interface. Also, instead of forecasting by revenue only, individual product revenue and units are required, to better support the operations planning process.

The database allows the account managers to configure account-specific items for the web interface, store the forecast numbers, perform simple financial calculations, and keep track of the changes on the forecast. The tool is accessible to sales managers when they need to negotiate the final forecast numbers with upper management before communicating to the operations planning group.

The tool provides visibility and accountability to the forecast data. The resulting forecast is more bottom-up, regional demand-forecast driven, instead of top-down, financially driven. With the forecast data in both units and revenue for each model, account managers and the operations planning group have an aligned goal. The powerful query report function allows sales managers to quickly obtain the desired data, resulting in significant time savings.

The project injected the discipline that the previous forecast process needed very much. It helps Kodak to achieve improvement in supply chain performance within D&AI. Currently, the number of users is roughly 20, but the tool can also be adopted for other product lines within Kodak in the future.

1.5 Overview of Chapters

This chapter provides an overview of Eastman Kodak Company and its position within the emerging infoimaging industry. It compares the difference between the traditional imaging and the digital imaging businesses. The chapter also contains the high-level objectives of the project, the approach taken, and hints the outcome of the project.

Chapter Two discusses the common forecasting methods. Both subjective and objective forecasting methods are presented in detail. Discussion regarding which method would be more applicable to D&AI Division at Kodak is presented.

Chapter Three describes in detail how the problem is approached. Steps taken to achieve the objectives are presented. It also includes details on how the final, proposed solution was derived and how buy-in from upper management was achieved.

Chapter Four presents the results from the research project. The implemented solution, a web-based forecasting data collection tool, is discussed in detail. It also includes feedback from actual users of the tool.

Chapter Five contains discussion of our results. Discussion includes how the Phase II implementation would improve the tool, the organizational process challenges faced during the internship, and whether the forecast process is appropriate for the company's digital camera strategy.

Chapter Six outlines the possible future work following this project. That includes the Phase II implementation of the tool and how the tool can be implemented across Kodak at other divisions. The chapter also discusses the possibility of using objective forecasting methods to forecast the total number of cameras throughout their life span.

Chapter Seven concludes the thesis with a summary of what was learned. That includes how the standardized web-based tool can help the financial and operations planning process and learning from the internship experience.

Chapter Eight contains the references used in this thesis.

Appendices include software specifications for Phase I and Phase II of the D&AI Forecasting Data Collection Tool, implementation timeline, user survey, and selected screenshots of the Forecasting Tool at its various stage of development.

2.0 FORECASTING METHODS

There are three kinds of lies: lies, damned lies, and statistics.
-- Benjamin Disraeli in Mark Twain - Autobiography.

Almost all business planning relies on some kind of forecasting process. According to the Merriam-Webster dictionary, the word "forecast" means "to calculate or to predict the future, usually as a result of study and analysis of available pertinent data." It is clear that we do not have the ability to accurately predict the future for all events. However, often times we can break down events into portions that may be unpredictable and other portions that may be more predictable.

One of the areas of the company that makes the most use of forecasting is production. Production departments need the sales / demand forecasts for the operations planning process. In production and operations management, factors such as trends, cycles, seasonality, estimates of competition behavior, and promotions, give us an advantage in predicting the future.

2.1 Characteristics of Forecasts

According to Steven Nahmias (1997),[3] there are five characteristics of forecasts:

1. They are usually wrong.
2. A good forecast is more than a single number.
3. Aggregate forecasts are more accurate.
4. The longer the forecast horizon, the less accurate the forecast will be.
5. Forecasts should not be used to the exclusion of other known information.

The most important characteristic is probably the first one on the list. Most people treat forecasts as known information. However, often times forecasts can turn out to be inaccurate even with the most sophisticated forecasting methods. That is why a fundamentally robust operations planning system that can handle unanticipated changes in demand may be more important than good forecasting processes.

The fourth characteristic on the list is the underlying assumption for many forecast processes. Companies usually update forecasts during forecast meetings with the assumption that forecast accuracy improves as one gets closer in time to the event being forecasted. While there have been studies, such as the one by O'Connor, Remus, and Griggs (1993),[4] on the cases where last-minute information may not improve forecast accuracy, as a result of overreaction to the revelation of the last actual value, I feel that the assumption holds, in general.

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[3] Nahmias, Steven, "Production And Operations Analysis," 3rd ed. (1997), Irwin, Chicago, 59-119.
[4] O'Connor, M.J., Remus, W. E., and Griggs, K. (1993). Judgmental forecasting in times of change. International Journal of Forecasting 9, 163-172.

The other three characteristics on the list are easy to understand. Items two and five are self-explanatory, while item three comes straight from statistics: The variance of the sample mean is smaller than the population variance. For example, for independently and identically distributed (IID) random variables, the variance of the sample mean is equal to the population variance divided by the number of random variables.

2.2 Forecasting Methods

Forecasting methods can be classified into two categories – subjective forecasting (sometimes called judgmental forecasting) and objective forecasting (or statistical forecasting). A subjective forecasting method means the forecasts are based on human judgments, while an objective forecasting method is one that the forecasts are derived from analysis of data.

While it can be argued that all forecasting methods are subjective, because the data and methodology are chosen subjectively for the objective forecasting methods. In the discussion follows, the definitions above will be used.

2.2.1 Subjective Forecasting Methods

Here are four major techniques suggested by Nahmias to solicit opinions for forecasting purposes:

1. Sales force composites
2. Customer surveys
3. Jury of executive opinion
4. The Delphi method

The first two techniques are self-explanatory. Because the sales force has direct contact with the customers, the forecasts generated by combining sales estimates from account managers are good indications of future demand and preference changes. Customer surveys serve similar purposes.

It is important to note that in order for the sales force composites method to work well, it is critical to have a proper incentive system. For example, if compensation for the sales force is based on meeting a quota, it is advantageous for the sales force to submit a lower forecast. The customer surveys method relies heavily on the proper design of the survey to ensure that the data collected are statistically unbiased.

Both the jury of executive opinion method and the Delphi method consist of soliciting expert opinions on demand for new products which may have no history. The difference between the two lies in the manner in which individual opinions are combined. For the jury of executive opinion method, the forecasts are generated from either the consensus of the group of experts or compilation of interview results. The Delphi method, on the other hand, tries to eliminate the possible shortcomings of group dynamics. Forecasts from individual experts are compiled and the experts receive the compiled forecasts with special attention to those opinions that are outliers. Next, the group is asked if they would like to reconsider their forecasts. The process is repeated until the result converges.

The forecasts using the jury of executive opinion method depends on the group dynamics of the experts involved. It allows the experts to share their conditional thought process, but the result is biased toward individuals with strong personalities and opinions. The Delphi method eliminates these effects given the majority of the expert options are actually the "correct" ones. However, it is more time-consuming as it is an iterative process, and there is no guarantee that the result will ever converge. Because there are no interactions among the experts, the thought process cannot be communicated. The design of survey or questionnaires is critical as it serves as the only means of communication.

2.2.2 Objective Forecasting Methods

Objective forecasting methods rely on data analysis. There are two categories of objective forecasting methods: Causal Model Method and Time Series Method.

- Causal Model Method – parameters related to the series being forecasted are used in the forecasting process, instead of using the underlying series itself. It is the basis for most of the regression models. An example would be an econometric model.

- Time Series Method – this method uses no information other than the past values of the underlying series being predicted. The idea is that past observation can be used to forecast the future values of the series. With the time series method, one tries to identify the patterns such as trend, seasonality, cycles, and randomness. It is also sometimes referred as the extrapolation method.

Causal model methods are commonly used for predicting economic phenomena, while the time series methods are more often used for operations planning applications.

2.3 Which Method Is Best For Digital Cameras Production?

Subjective, or judgmental, forecasts are perhaps the most widely used for important forecasts.[5] However, the objective method is needed under some circumstances, because it is less expensive than the subjective method. For example, if one needs to forecast demand for 10,000 items every week, it would be extremely costly to use subjective methods. There are also studies that show the subjective forecasts are subject to many biases such as optimism and overconfidence

[5] http://www-marketing.wharton.upenn.edu/forecast/FAQ.html

(see Kahneman, Slovic and Tversky 1982).[6] So which method is the best for predicting the demand for digital cameras?

To answer this question, we should look into some of the characteristics of digital cameras.

- Short product lifecycle
- Fierce competition with perishable demand
- Thin profit margin (often declining with time)
- Insufficient historical data
- Volatile demand (heavily dependent on promotion and design)

A good example of volatile demand would be the demand for the current generation of Kodak digital cameras. Introduced in the middle of 2001, the design allows the user to connect a docking cradle so that the camera can be quickly snapped on for uploading pictures while charging the rechargeable batteries at the same time. The docking station design was a hit and forecasts underestimated the demand. During the Christmas season of 2001, most of the digital cameras from the latest product family were sold out at major retailers.

The first decision to be made in the Selection Tree for Forecasting Method[7] published by the Marketing Department of Wharton School is whether there is sufficient objective data. Given the characteristics for digital cameras, the subjective forecasting method is likely to be the appropriate choice.

Forrester Research (2001)[8] concurred that "Firms must brace for difficult-to-predict changes in demand. To control margin performance, firms need a new business strategy based on continuous demand management tools." and "Statistical forecasts from historical demand won't work any more."

Among the four techniques mentioned earlier for collecting subjective opinions, each of them has its own merits and weaknesses. In my opinion, the best method would be a combination of the best portion of each technique. Ideally, I wanted to design a forecasting process that would take into account sales force and customer feedback, and would be adjustable by expert opinions. With the support of data from the sales force, it will be less likely that the expert with a strong personality will disproportionately affect the forecast outcome.

A good forecasting procedure is one that improves upon the procedure that is currently being used, or that is better than other reasonable alternatives. *The goal here is to create a process that takes the most rational use of all available information, both from subjective understanding of the market and available quantitative data.* Therefore, the proposed forecast procedure would be an improved version of the current system, following the philosophies described in this section.

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[6] Kahneman, Daniel, Paul Slovic, and Amos Tversky (1982), Judgment Under Uncertainty. Cambridge: Cambridge University Press.
[7] http://www-marketing.wharton.upenn.edu/forecast/paperpdf/SelectionTree.pdf
[8] Forrester Research, October 2001

3.0 METHODS

Don't select the weapon before you know the fight.
-- Al Drake on a suggestion made by the author to use system dynamics to attack the project

Coming fresh out of a consulting assignment with QUALCOMM through the Application of System Dynamics course at MIT, "guns blazing" probably best described me when I first showed up at Kodak. The idea of using a system dynamics model to simulate the digital camera supply chain was ingrained in my mind even before I met any of the personnel at D&AI. I expected the project to contain complex models and mathematical formulas.

Two things changed my mind: The first was the advice given to me by my engineering advisor, Professor Al Drake. He wanted me to understand the situation better before I chose the tools to address the problem. The second came when I met the Director of Integrated Supply Chain at D&AI. After I expressed to him my intention to model the digital camera supply chain using a system dynamics tool, I was told that while the complex model might have good academic content, the model would never be used after I left Kodak.

I feel that it is most important to satisfy the key stakeholder, in this case, Kodak. Compared to the academic research projects I have conducted in the past, the six months I spent in the D&AI Division at Kodak provided a completely different kind of challenge. I found myself immersed in an unfamiliar business setting, trying to discover and, ultimately, implement change.

3.1 Sloan Leadership Model

Instead of using the system dynamics model to attack problems that I had not yet even encountered, I decided to approach the project by loosely following the Sloan Leadership Model. I felt that the Sloan Leadership Model was appropriate because it is a much more general tool compared to tools such as linear optimization and system dynamics modeling. The main objective of the internship was to identify improvement opportunities and implement change. The main challenge for the project was not the technical aspect, but rather, the change and implementation aspect. The project was also an ongoing process and I wanted to make sure that the changes would have a lasting impact on the organization.

The Sloan Leadership Model contains six steps for catalyzing action.[9] **Figure 1** below best summarizes the model:

[9] Ancona, Deborah. "Leadership at Sloan" handout from 15.317 Leadership and Change in Organization. IAP 2001.

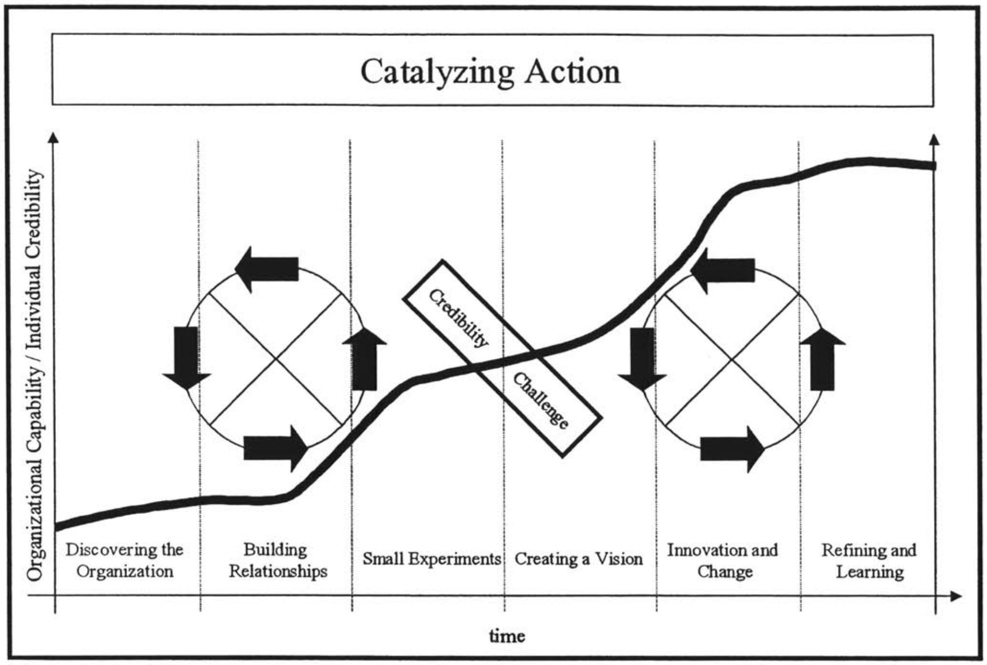


Figure 1: Catalyzing Action steps from the Sloan Leadership Model

The two groups of circular arrows represent the continuous improvement aspect of the model. It is not a step-by-step sequential process, but rather, a process with continuous feedback between each step.

I based my method of problem solving loosely on the Sloan Leadership Model. Between the Building Relationships and Small Experiments steps, I added a step called "Identify Opportunities." Compared to the catalyzing action, the nature of my internship involved problem solving in a business setting. Therefore, I felt I needed to modify the model slightly for my internship.

3.1.1 Discovering the Organization

During a talk given by John Reed, the former Chairman and CEO of CitiCorp, he mentioned that whenever he started out in a new position, he would always dive into the organization and get to know the people and find out how exactly things work. While the Sloan Leadership Model did not exist back then, what he described is exactly the first step of the catalyzing action.

The first thing I tried to do when I arrived at Kodak was to understand the situation, environment, and culture of the company. While the project itself was not yet shaped, I knew the nature of the project would be related to digital camera supply chain improvement. Therefore, I tried to achieve two objectives at this stage of my internship:

- Introduce myself to the organization by attending most meetings – during the first month or so, I would try to meet as many people within the D&AI Division as possible. Some of the meetings I attended were not relevant to my project. (For example, the meetings for the SAP issues.) It was a good way for me to learn the environment and corporate culture of D&AI and to identify possible projects for my internship.

- Identify key individuals relevant to the research project – through attendance at all of the meetings, I was able to meet people ranging from corporate vice presidents to other summer interns. I started a folder that contained notes taken during meetings and contact information for most of the key individuals.

It is interesting to note that the D&AI Division of Kodak actually has a small company feel to it. Because of the nature of digital imaging industry, the division needs to be nimble and quick-reacting in order to compete effectively.

3.1.2 Developing Relationships

Step two in the model is developing relationships. This is not a one-time process, but rather, a continuous process. Relationship building is especially important in a large corporate setting where a project generally involves many stakeholders.

I mentioned earlier that the challenge for the project would not be the technical aspect, but rather, the change and implementation aspect. For this reason, relationship building is extremely critical. I took the following steps to develop relationships:

- Set up meetings to interview key individuals – once I started to narrow down the scope of my project, I started to set up interviews with key individuals with whom I identified to be relevant to the project. The purpose of the interviews was three-fold:
    - Introduce myself to the individuals / organization
    - Build relationships
    - Collect relevant information for the project

- Constant contacts through weekly and monthly meetings – the meetings were critical to keep me updated with the latest development within D&AI and to keep in touch with individuals attending the meetings. Consistency in relationship building was important for building credibility at the initial stage.

- Phone call / E-mail / Teleconference – because of the geographical separation for key members of the project (most of the account managers and sales managers were located off-site; they either worked at home or traveled most of the time), it was important to keep relationships up by constant contact through phone calls, e-mail, and teleconferencing.

3.1.3 Identify Opportunities

After the initial phase of gathering data regarding the digital camera supply chain, it was determined that D&AI had been making good progress in the right direction toward supply chain performance, but there were still opportunities for improvement.

I tried to understand the monthly Sales & Operations Planning (S&OP) process used by D&AI so that I could identify potential improvement opportunities. I also wanted to make sure that the identified improvement opportunities did not conflict with or duplicate other ongoing or planned future improvement processes.

The S&OP process is a multi-step process that requires different inputs. We can break it down into the following steps:

1. Define products and street price points over the next two quarters and use them as the basis for S&OP process and financial estimate processes.

2. Arrive at approved worldwide sales forecast (by region / by model / by month for the next 12 months) for use in S&OP and financial planning processes.

3. Communicate to the Production Supply Team the production required to meet the current sales plan, given the inventory strategy, capacity guidelines, and starting conditions.

4. Verify the ability of production / supply to meet demand.

5. Incorporate adjustments from operations planning meeting into overall plan for review and approval at the S&OP meeting.

6. Approved PSI (Production, Sales, and Inventory) plan becomes the single set of numbers for executing business operations and meeting corporate goals.

The approved PSI plan is then used in the weekly RHS (Rolling Horizon Schedule) and Procurement Authorization processes[10]. Weekly production plan and long-lead component plan are created with the latest monthly sales forecast, current inventory, inventory goal, and production capacity.

12 weeks RHS are communicated to the manufacturers weekly, with the first 4 weeks (week 0 to week 3) being "*fixed*" (committed to the amount), the next 4 weeks being "*firm*" (changes up to plus or minus 25% range of the week 8 plan when the plan rolls into week 7), and the last 4 weeks being "*plan*" (100% flexibility).

[10] D&AI Weekly RHS and Procurement Authorization presentation. 5/2001.

Figure 2[11] below represents the S&OP process with the corresponding inputs for each step:

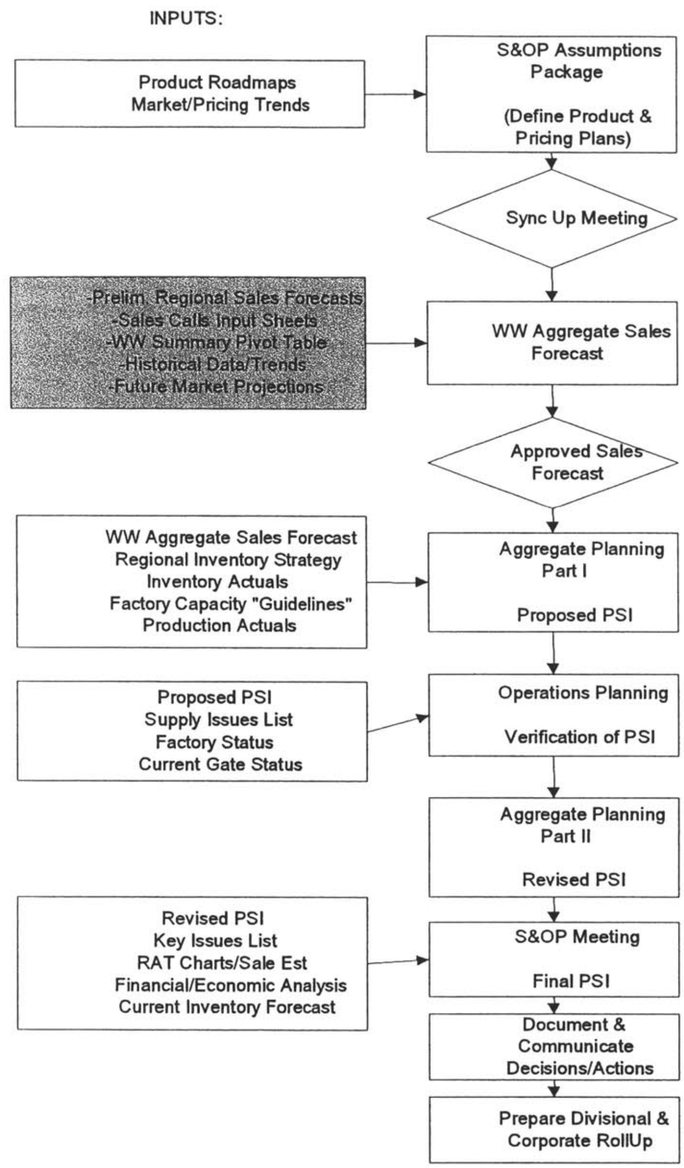


Figure 2: S&OP Process for the D&AI Division

Upon reviewing the current process, I believed there were two opportunities for improvement within the process that would make a good LFM internship project:

1. Improve the process for gathering preliminary regional sales forecasts – highlighted on the chart above, the preliminary regional sales forecasts are the fundamental building block of the S&OP process. "Garbage In – Garbage Out" is the concept that is especially

[11] D&AI S&OP Re-Engineering presentation. 2/2001.

true for this process, because the result of the process depends heavily on the input. Therefore, special care must be taken to assure that proper data are used.

2. Automation of the process – many steps within the S&OP process require manual manipulations of data. In those steps, input from various sources, such as actual sales numbers, regional sales forecasts, current inventories, etc. need to be manually compiled into Excel spreadsheets.

Further investigation revealed that there was a plan to automate the current S&OP process by implementing the Demand and Supply Management (DSM) module from Manugistics. The DSM module combines the manual inputs and automatic feeds from existing databases to generate an aggregate sales forecast and item level planning. Manual inputs for DSM include market size projections, market intelligence, desired inventory level, production capacity guidelines, and regional forecasts. The rest of the required data, actual inventory level and actual sales, are automatically populated from the database. Please refer to the **Figure 3**[12] below for the operations of DSM.

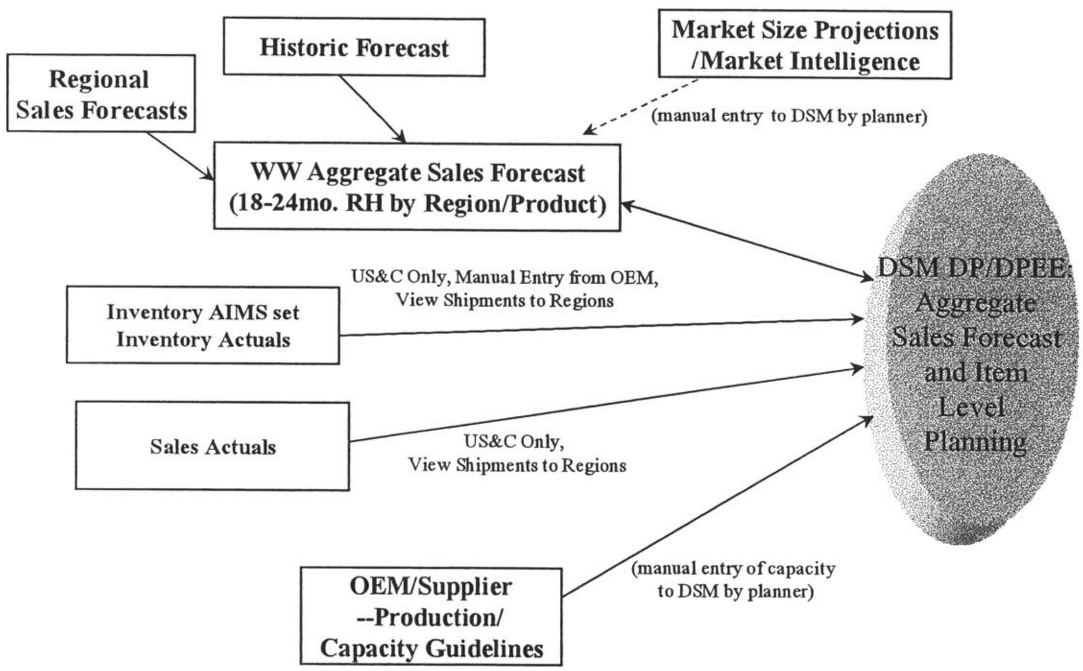


Figure 3: Operations of DSM

It is interesting to note that DSM actually has a forecasting module that uses historical data to generate objective forecasts. The module has been implemented on the traditional imaging (film) group of Kodak with very good results. However, one of the key inputs to the sales forecasting process within DSM is a minimum of three years of sales history are required for

[12] D&AI Supply Chain Core Team Projects presentation. 4/2001.

statistical modeling.[13] As discussed in Chapter Two, because of the insufficient historical data and short product lifecycle, I feel that objective forecasting methods are less suitable (compared with subjective forecasting methods) for digital cameras.

After numerous interviews with selected account managers, sales managers, and relevant personnel in the supply chain group, several issues with the current regional sales forecasts process were identified:

- The current process of forecast collection is very non-uniform. The communication between the account managers (who interact directly with the customers and report to the sales managers) and the sales managers takes on various forms, ranging from phone calls and voicemails with a single number, to e-mail with detailed Excel spreadsheets attached.

- Visibility of the forecasts is low. By attending a few sales conference calls and meetings, I learned that there was no shared, centralized forecast accessible to every stakeholder. It is also easy for the forecasts to be overshadowed by the opinions of experts who have stronger personalities.

- Currently, the forecasts are financially driven. The current forecasts are set to meet the corporate financial target. Hence, this results in a forecast designed to "make the number." Bottom-up sales demand forecasts would better reflect true demand.

- Forecasts in units are not provided. Aggregated item level forecasts in units are critical for operations planning.

The combination of the findings above defined the goal of the project: Improve the process for gathering regional sales forecast. We wanted to achieve the following:

- Have a systematic way of collecting demand forecast data
- Increase forecast data visibility
- Increase accountability for the account managers
- Have more discipline throughout the forecasting process

3.1.4 Small Experiments

Once the project scope was narrowed down, the interviewing process was continued to build relationships and gather data to determine the requirements for the initial pilot test. There are a few reasons for the pilot test:

- Gauging interest from the stakeholders
- Building momentum for the project
- Testing assumptions
- Learning from the experience

[13] Demand and Supply Management: Sales Forecasting – Module 2 Ver. 2.03. 6/2000.

The initial prototype tool was created after soliciting opinions from account managers and sales managers. A tool serving a similar purpose from the Health Imaging (HI) Division was also studied.

The resulting prototype tool was an Excel-based pivot table database with minor Visual Basic functionalities. The main spreadsheet was linked to multiple, separated spreadsheets (one for each account). When an account manager updated his or her account, the central spreadsheet would update the corresponding fields if given the refresh command.

The tool performs data filtration through the use of the pivot table. It allows the users to view desired forecast data and performs basic calculations. The pivot table consists of four selection criteria: Account manager, customer, LOB (line of business), and quarter of the year. Users have the option to select a single or multiple items from the dropdown menu for each selection criteria. The filtered data would then appear in the spreadsheet and sums for both vertical columns and horizontal rows are calculated automatically. A toggle switch allows the users to switch between quantity and revenue. Please refer to Appendix A for the screenshot of the prototype.

While most of the people who saw the prototype tool believed that it was an improvement over the existing process, the prototype tool failed miserably in several aspects:

- Accessibility – the spreadsheets were located on a Windows NT file server in Rochester. Many users had problems accessing the tool when not on site. Many also did not have access to the particular file server.

- Practicality – for those who could access the tool, every time a query function was executed, the data behind the pivot table needed to be transferred to the local computer as well (per session). Because of the particular construction of the pivot table (four different filtering fields), the size of the data file was very large. Actually, the data sheet exceeded the 65536 rows limit of Excel when there were more than 26 accounts! It was almost impossible for users with dial-up connection to use the tool.

- Interface – the interface of the tool was functional, but not the most user-friendly. Technical skill levels vary widely among the users of the tool as well. There were people who could adapt to the new tool very quickly, while some could not find the "My Network Places" icon on the desktop.

The prototype tool was not successful at collecting forecast data because it was not easily accessible, not user-friendly, not efficient, and not robust enough to properly collect the data globally. However, it served its purpose as a learning experiment. Many assumptions made were proved to be incorrect. For example, the accessibility issue for the account managers and the capability limitation of Excel. The "learning from experience" was very valuable.

I felt the experiment did not achieve the purpose of momentum-building, because after this preliminary experiment, we realized that a brand new platform for the tool was needed. A lot of the work done for the first prototype could not be transferred to the next generation tool.

3.1.5 Creating a Vision

After the valuable learning experience from the experiment, we had a good idea what a much better tool would be. The vision was to create a tool that improves the process for gathering preliminary regional sales forecasts by automating and standardizing the process as much as possible. It needed to have a familiar and user-friendly interface and be easily accessible by all users with minimum data transfer.

- Easily accessible – the tool would be web-based so that it could be accessed from anywhere given that the person had Kodak intranet access.

- Familiar interface – we wanted to make sure the new tool would have a familiar interface to the users. Minimal training would be required for all users starting to use the tool.

- Efficient – the tool had to make life easier for the users. It had to be efficient with minimal uploading and downloading of data. It would also automate some of the most routine procedures.

- Robustness – the tool had to be built upon a more powerful platform to accommodate future expansion. We wanted to make sure the tool would be able to handle the amount of data needed as the business grows.

The goals we tried to achieve with the tool are still the same as mentioned earlier in the Identify Opportunities section.

3.1.6 Innovation and Change

In the innovation and change stage, the following milestones were set:

- Define tool functional requirements – functional requirements were refined after learning from the experiments. Feedback from the test users helped shape the tool tremendously.

- Present business case to management to justify using a professional programmer – after the decision for building the tool on a more powerful platform was made, we decided that a professional programmer was needed for the task. The tool would have a web front end, with a powerful database engine (such as an Oracle database) on the back end.

- Create the software requirements specification - a software specification was created to gauge the cost and feasibility of the project. The software specification was not the same as the functional requirements, although there were some overlaps. The software specification was very specific and would communicate to the programmer exactly what the tool would look like and how it would function. It was created as a collaboration between the programmer, sales managers, account managers, and me. Please see Appendix B for the initial software requirements specifications.

- Propose implementation time line to upper management – present the implementation time line to management to achieve buy-in. It was important to build the credibility of the project, as well as personally, by showing a well thought out plan. Please see Appendix C for the proposed time line for implementation.

- Execute implementation – as a result of the constraints on resources within D&AI, the project was broken down into two phases. Phase I was being implemented in Q1 of 2002, while Phase II was scheduled to be implemented in Q2 of 2002.

During a brainstorming session, one of the team members suggested building the tool on top of the database (D&AI Data Warehouse) that was currently being used. In this way, the need for having a familiar interface could be easily satisfied. A survey to gauge the familiarity of the D&AI Data Warehouse was sent out to the potential users of the new tool. The responses were overwhelming. More than 80% of the responses indicated that they actually used the D&AI Data Warehouse on a weekly basis.

Because the new tool would be linked electronically to the existing database, it would automatically populate information such as SKU numbers, item descriptions, etc., directly into the interface of the new tool.

3.1.7 Refining and Learning

The implementation process involved continuous feedback that led to further refinement and learning. During the coding process of the tool, there was continuous communication between the programmer and me. At every milestone of the tool development process, such as when a major functionality was completed, the tool would be evaluated, initially by me, and then by a few selected account managers. The feedback provided would further refine the tool, even during the development process. We wanted to make sure that the tool was developed with the users, so when they start using the tool once it was rolled out, there would be no surprises.

A few key features that the account managers felt very strongly about were added as a result of the feedback from the testing process. One of the features was the ability to sum up the monthly columns during the data input process. This would allow the users to easily compare the monthly forecast to their quotas. Upon receiving the feedback, the idea was communicated to the programmer and the feature was added to the tool.

While the example may sound very intuitive, the request for that functionality only came up after the testers started to use the actual tool, not during the initial requirements-gathering process. It shows the importance of refining and learning from the testing procedure.

When the initial prototype of the web-based tool was completed, a formal testing program was established. Instead of selected few testers, all account managers and sales managers were asked to participate. As of April of 2002, the tool was being used by roughly 20 people within the D&AI Division.

4.0 RESULTS

Errors using inadequate data are much less than those using no data at all.
-- Charles Babbage (1792-1871)

As of April of 2002, Phase I implementation of the D&AI Forecasting Data Collection Tool was completed. The tool was hosted at the D&AI Data Warehouse to ensure that it would be easily accessible. Users who were given access to the forecasting tool see the link to the tool when they access the Data Warehouse website. Roughly 20 people within the D&AI Division are using the tool, including 14 account managers, 2 sales managers, and other relevant personnel.

Ideas for functionality enhancements that will be implemented in Phase II came from one of two sources: Feedback from current users and features that are valuable, but were not feasible during Phase I due to resource constraints. Major enhancements will include an automatic net realized revenue calculation, the ability to work off-line, a more flexible catalog number setup function, and an enhanced query report function.

The latest functional requirements for the Phase II implementation have been finalized by the team at D&AI after I left. (See Appendix D) The implementation will start in Q2 of 2002.

In this chapter, the Phase I implementation of the D&AI Forecasting Data Collection Tool will be discussed in detail, both in terms of technical and functional aspects. A summary of feedback from users of the tool is also included for comparing the new process to the old one.

4.1 D&AI Forecasting Data Collection Tool

4.1.1 Technical Aspect

The architecture of the D&AI Forecasting Data Collection Tool consists of three different layers:

1. The client - requires only a web browser
2. The web server - contains all the business rules and processing
3. The database – the object-relational database used by Kodak is Oracle 8i

The forecasting tool consists of three pieces of Visual Basic code which reside on the web server:

1. The data entry function to add catalog numbers to an account for forecasting. This is contained in a program called the "Web Agent" which manages the web interface with the user.
2. The spreadsheet with Visual Basic macros to maintain the forecasts, which uses RDS (Remote Data Services) to talk to the back-end.

3. The back-end part to the spreadsheet, which reads and writes to the database.

The standard query reports that summarize forecasting quantities and / or revenue are written in Microsoft Access with some internal VB modules. They produce files in either PDF (Portable Document Format) or Excel spreadsheet format as outputs.

When a report is requested, the "Web Agent" saves the request and parameters for the report in the database. A "Report Agent" checks for the requests and activates the "Report Setup" program which takes the parameters for the report that is about to be run and passes them into an Access database form from which they can be used when the report runs.

All processing is done on the web server with the exception of the forecasting spreadsheet. When a user requests the forecasting spreadsheet it is downloaded to the user machine and run locally, using RDS to talk to the component on the web server.

4.1.2 Functional Aspect

The D&AI Forecasting Data Collection Tool consists of four major functions:

1. **Account Maintenance Function** – This function allows the forecasting tool administrator to assign accounts (with Kodak's internal corporate customer numbers) to account managers. (i.e., link account manager 1 with account A, B, and C.)

2. **Account Manager Catalog Number Maintenance Function** – This function allows the account managers to select catalog numbers for each of their accounts. A dropdown menu allows the account managers to select a particular account during the setup process. The menu will only consist of accounts for which that particular manager is responsible.

   During the setup process, the application automatically checks the catalog numbers entered against the database within the D&AI Data Warehouse. If the catalog number is not in the database, an error message will ensue and the catalog number entered will not be saved. Otherwise, the product description (automatically populated from the Data Warehouse) for each catalog number will be displayed.

3. **Sales Forecast Maintenance Function** – This function allows the account managers to enter the forecast for the next 12 months. As described in the previous section, an Excel spreadsheet is used for the forecast inputs. The spreadsheet is made up of pre-determined catalog numbers (selected in the account setup process described above) as the vertical axis and the months as the horizontal axis. Both units and revenue forecasts are required for the forecast.

   Forecast numbers for the next month will be locked out at the end of the current month. The account managers are presented with current month out to 12 months and will be unable to update current and past forecasts by design.

Changes in forecast numbers will be recorded with time stamps in a "history table." This will allow the users of the tool (not just the account managers) to track the forecast progress in the future when the interface for viewing the table is implemented in the next phase.

4. **Sales Forecast Reports Function** – This function allows the users of the tool to view the content of the forecast database in the form of customized reports. Currently there are two basic reports, quantity forecasts and revenue forecasts. Each report can be customized by multiple leveling of the filtering process. Note that account managers only have access to their own forecasts by default, while sales managers can query the entire forecast database.

   The filtering criteria for the reports include "beginning month / year" (default setting will be current month), "region," "account manager," "account," "LOB" (Line of Business, for example, inkjet, digital camera, etc.), and "catalog number." The "account manager" and "account" fields are hierarchically linked, just like in the Account Manager Catalog Number Maintenance Function, meaning once the account managers are selected, only their accounts will appear on the next menu.

   The resulting reports contain forecast numbers for each catalog number as well as the monthly sum for each LOB and the overall monthly sum.

Please refer to Appendix E for selected screenshots of the actual tool.

4.2 Feedback From Users

A survey was sent out in April of 2002 to the users of the D&AI Forecasting Data Collection Tool after the tool was rolled out. The purpose of the survey was to understand the effectiveness of the tool in the process improvement aspect. It consisted of six questions designed to compare the current process with the old process and to gauge the significance of the new tool. Approximately 50% of the users responded to the survey. Please refer to Appendix F for the actual survey.

The tool was mostly used by the account managers and the sales managers, while people in the financial and operations group used it occasionally. The survey results were quite different from each different group of users. The results of the survey are presented below in a format that contains the numerical average and selected comments made by the users. The numerical scale used in the survey is as follow:

0 – Not At All
1 – Somewhat
2 - Yes
3 – Very Much

4.2.1 Account Managers' Perspective

Number of responses: **8**

1. Has the new forecast tool made your monthly forecasting process easier? Average Score: **0.75**

"It is easy to use once established."
"From an account manager level the old system was faster and easier."
"I can see where, down the road, it will make it easier, but the current process is not as efficient as my old method. I still have to enter all of the formulas in the spreadsheet."
"I do my own forecast by week."
"The spreadsheet is not detailed enough. It could be nice once completed."

2. Does the new tool save time? Average Score: **0.25**

"Since I have to do my own forecast in addition to this one, no. But it could be once upgraded."
"The old system was faster and easier."
"A small amount given we don't have to fill in the SKU numbers more than once."
"Not yet. I have to calculate all of the formulas and NRR each time."
"Manual calculation of revenue is time consuming. If automatic, this is a great tool."
"I have to do a forecast by week, not by month."

3. What are the benefits of the current tool compared to the old one?

"None."
"They can be rolled up into an aggregate forecast for management and supply chain uses."
"The only benefit I see at this time is for corporate, but I can see it being very nice once upgraded."
"The benefit is to better manage the collective information, but the process does not benefit the individual account manager."
"Our management can pull it up online vs. having to send it via e-mail."

4. Knowing that the Phase II tool will be built with the feedback collected from using the current tool, do you think the Phase I implementation (the current tool) is necessary? Average Score: **0.8**

"Have no idea what you are asking."
"I have no knowledge of Phase II"
"You have to start with a foundation, and then built appropriately to the specific needs later."

5. Will the Phase II tool be much more useful? Average Score: **1.2**

"I have no knowledge of Phase II, but I am sure there will be an improvement.
"If it includes better descriptions / NRR formula's loaded / being able to see your current month forecast for reference."

"Only if it helps to get more product."

6. Do you think the implementation of a web-based standardized tool in general is the right way to go in the future? Average Score: **2.375**

"It is very important to have a web-based tool and we all know the project is evolving."
"It will be great to have it centralized."
"Automation for roll up forecasting to management is extremely important."
"It certainly will allow easy access by all parties to the data. And when the complete tool is up and running, it should be a time saver."
"It could be if you take our suggestions and implement them."

4.2.2 Sales Managers' Perspective

Number of responses: **2**

1. Has the new forecast tool made your monthly forecasting process easier? Average Score: **2**

"As a manager it is great to get one consistent format from my whole team. As you know in the past no two forecasts looked the same."
"Spreadsheet not detailed enough. Should have NRR cost and sum."

2. Does the new tool save time? Average Score: **2**

"The ability to select by rep or by team is very convenient."
"Account managers have created their own forecasting sheet, now they have to work on this spreadsheet."

3. What are the benefits of the current tool compared to the old one?

"Consistent format, consistent formulas, the built in cut off forces our rep to make the deadline for submitting their forecasts."
"All account managers working from the same spreadsheet."

4. Knowing that the Phase II tool will be built with the feedback collected from using the current tool, do you think the Phase I implementation (the current tool) is necessary? Average Score: **1.5**

"We had to start somewhere."
"We forced people to acknowledge the tool and drove them to voice their likes and dislikes."
"I would have prefer working from Phase II with all the bugs worked out first."

5. Will the Phase II tool be much more useful? Average Score: **3**

"Yes, the tool should address some of the small inconveniences of Phase I."

"Hard to answer until Phase II is available."

6. Do you think the implementation of a web-based standardized tool in general is the right way to go in the future? Average Score: **2**

"One concern I have heard from the sales team is that they would like to work "off-line" and then upload the data at a later point."
"I only have to go to one source."

5.0 DISCUSSION

You can never plan the future by the past.
-- Edmund Burke in a letter to a member of the National Assembly

The best of prophets of the future is the past.
-- George Gordon Noel Byron, Lord Byron

From the two quotes above, we see that different people can have completely different opinions toward the same issue. Is the new forecasting tool effective? Can we explain the reactions from the users? Is Kodak's forecasting process aligned with its business strategy? These questions will be addressed in this chapter.

5.1 Tool Evaluation

From the user feedback in Chapter Four, we see that the opinions of the account managers and the sales managers are vastly different.

From the account managers' point of view, the new tool still lacks a few features that will make the tool truly useful. And because it is a brand new tool, many felt that it creates new work for them because it forces them to do things in a standardized way. However, most agree that the centralized, web-based tool approach is the right way to go.

From the sales managers' point of view, the new tool is useful. It saves time by eliminating all the non-standardized inputs from the account managers. Moreover, it provides a powerful report generating function that allows the sales managers to customize forecast reports.

It is interesting to note that most of the complaints regarding the functionalities with the new tool were considered during the software development process. The only reason why they were not implemented in Phase I was because of the limited resources within D&AI. For example, on the top of the list of account managers' request was the automatic NRR (Net Realized Revenue) calculation. The function was actually initially in the Phase I software specification but removed later on due to the resource constraint.

It was also decided that a two-phase implementation plan would allow the users to have more time to adapt to the new tool. With the Phase I implementation, it also gave the users a chance to provide feedback to shape the next generation tool.

5.2 Organizational Process Issues

Analyzing the project using the three-lens approach[14] (strategic design, political, and cultural aspects), I feel the political aspect was one of the most interesting parts of the internship. Three steps were taken for the analysis:

1. Identify and map the relationships among the different stakeholders involved.
2. Uncover the interests and goals the different stakeholders bring to the interaction.
3. Assess the amount and sources of power of the different stakeholders.

Figure 4 below represents key stakeholders causal relationships. Arrows represent direct reporting relationships, and operators indicate level of support: "+" is high support, "–" is low support, and "?" is unknown. Note that indirect relationships can also impact project dynamics, such as account managers impacting this project indirectly through sales managers.

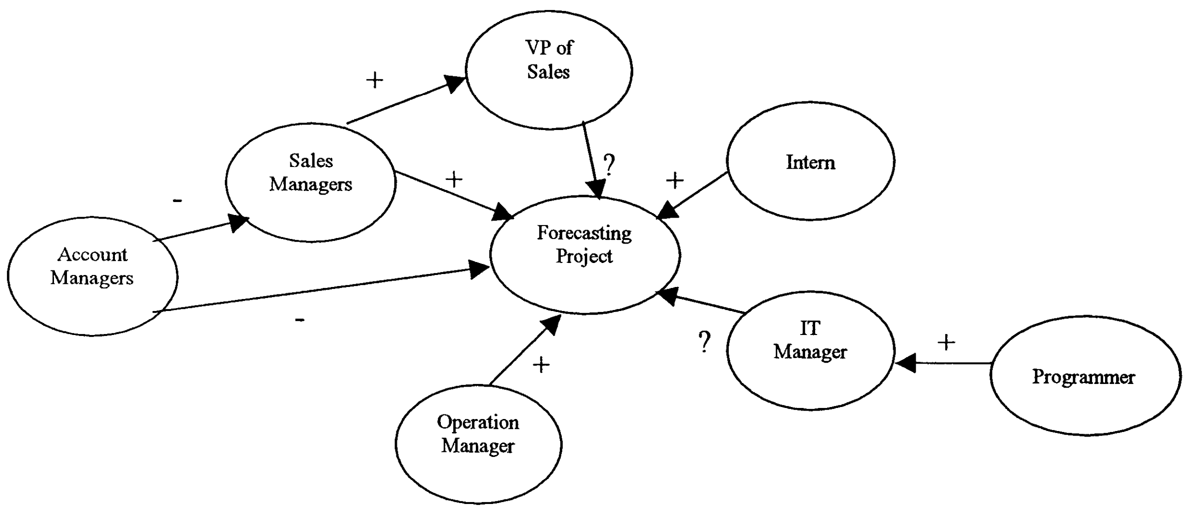


Figure 4: Key Stakeholders Causal Relationships

As mentioned in Chapter One, the goal for the project was to implement a tool that would inject discipline through the forecasting process. This means the forecast data entered by the account managers would be stored in a central database and would be accessible by other users for operations planning process.

Currently, up to several thousand dollars of annual compensation for the account managers is tied to the on-time usage of the forecasting tool. In Phase II, the tool will keep track of the forecast accuracy, and the incentive system for the account managers will be tied to their accuracy. This obviously creates a conflict of interest.

While the majority of the key stakeholders are supportive of the project, the inherent conflict of interests described above means the account managers had no incentive to help out the project.

[14] Ancona, Kochan, Scully, Van Maanen, Westney. "Managing For The Future: Organizational Behavior & Processes", (1999). 40-60.

Currently the tool is creating more work for them (according to the survey result), because they are "forced" through the incentive system to adapt to the new system. And once the project is implemented fully, the account managers will need to start forecasting more accurately to earn their bonuses!

However, it is critical to design an incentive system that is aligned with the goals of the company. If the account managers are compensated heavily for forecast accuracy, then they might set a lower target and then hold back on sales even when they have the opportunity to sell more. On the other hand, if compensation is not tied to the forecast accuracy, wild forecasts will create problems for the supply chain. So the situation needs to be very delicately balanced.

Both the VP of Sales and the IT manager's interests were questionable. The reason for the uncertainty for the VP of Sales is because once the database is implemented, it would be harder for him to impose his personal modification to the forecast (less power). But it would still be in his best interest to have a better forecast.

As for the IT manager, the uncertainty was for a completely different reason. The IT manager needed to manage the limited resources within the division. Previously, there had been some bad experiences regarding implementing IT tools. Basically, a few databases were implemented but ended up not being used. That is why the IT manager was somewhat reluctant in supporting the project.

The power structure within the group was not changed greatly after the project implemented. The most likely outcome will be decreasing the power of the account managers and the VP of Sales, while increasing the power of the sales managers.

Being an intern, I did not have positional power over most of the key stakeholders. So the approach I took to achieve the goal was by implementing the project step by step. The first phase of the project only required the account managers to use the tool. No accuracy-measuring matrix was implemented. In this way, it was easier to get buy-in from the account managers. Once the tool becomes part of their everyday life, the second phase implementation will tie their incentive system to the forecast accuracy. I also relied on voicing my opinion and ideas sometimes, through the operation manager and sales managers, as they are supportive of the project and they have positional powers over the account managers.

It is also interesting to note that the acceptance level of the tool varied greatly, depending on the involvement of the party during the development stage. Because the survey was not anonymous, the results from different groups of account managers and their sales manager were different as well. (One group was involved during the development stage while the other one, which had mostly account managers with only a few month of experience within D&AI, was not.)

The group that helped to develop the tool, while providing honest feedback regarding the lack of certain functionalities, was generally positive about the current tool and the outlook of the next generation implementation. In contrast, the other group did not acknowledge much value of the tool nor what the team was trying to achieve. I feel the vision was not communicated well to the team of account managers with less time within D&AI and the result was less buy-in for the tool from those individuals.

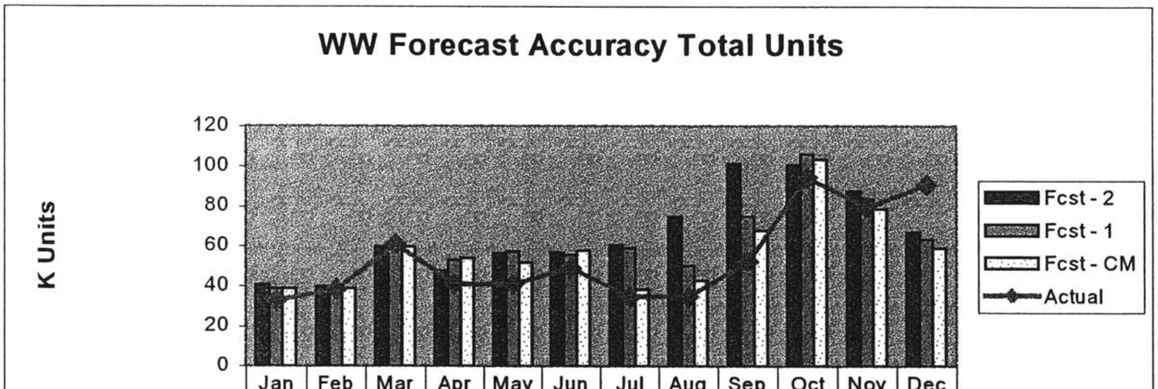
5.3 Forecasting & Kodak's Business Strategy

As mentioned in Chapter One, the digital imaging business has the following characteristics:

- The market is crowded with competitors.
- Product life cycle is relatively short, typically ranging from 6 to 12 months.
- Digital cameras contain long lead-time parts, up to 16-21 weeks on some components.
- There is not much history to rely upon for modeling.
- Thin profit margin and usually declining with time.
- The demand is perishable.

It was also mentioned that while the present goal for the traditional imaging business is profit generation and market penetration, the acquisition of new customers is presently a focus of the digital imaging business.

Figure 5 below shows the worldwide forecasts vs actual sales numbers for D&AI in 2001. Absolute numbers are disguised due to confidentiality. Three forecast numbers are given for each month. Fcst – CM is the forecast made in current month, while Fcst – 1 and Fcst – 2 are numbers that were forecasted one and two months ago. (Account managers typically forecast 6 to 12 months out from the current month.)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fcst - 2	40.6	39.8	59.6	47.9	56.8	56.8	60.8	75	101	101	87.8	67.2
Fcst - 1	38.9	38.7	60.1	53.2	57.4	55.6	59.1	50.1	74.9	106	84	63.5
Fcst - CM	38.9	38.8	59.6	54.2	51.8	57.7	38.7	43	67.9	103	78.9	59.1
Actual	32.9	38.5	61.3	41.5	41.1	49.4	35	34.9	52.8	94.6	80	90.9

Figure 5: World Wide Forecast Accuracy of Total Units

Mentioned in Chapter Two as an example, digital cameras from the latest product family with the new docking stations were sold out in many retail stores during the Christmas season in

2001. The underestimation of the demand for the latest line of cameras was the major contributor for the large gap between actual sales and the forecast number in December. (All four models in the new product family were under forecasted for both November and December.) During that period, Kodak's sales teams were forced to allocate the limited products to only a few selected retailers.

Given the long lead-time on digital cameras, demand in excess of forecast are satisfied by competing products, as there is a high substitutability of demand. From **Figure 5** above, the gap between the forecasts and the actual sales in December was roughly 50% of the actual sales. (The majority of the gap came from the US & Canadian region forecast, with one of the models contributing 73% of the underestimation!)[15]

With perishable demand and long lead-time, can Kodak afford to under forecast if the main objective for the digital imaging business is to penetrate the market and acquire new customers? For Kodak, is the inventory holding cost "cheaper" than losing the market share? Because profit margins decline with time after initial introduction, it is especially costly to under forecast a new camera line.

For Kodak's digital imaging business, maybe an accurate forecast on the total number of units sold throughout the product's life span is more critical than trying to achieve minimum inventory each month. If an accurate forecast can be achieved on the total number of units for a particular camera line, we can carry more inventories up front to hedge the possibility of lost sales while the product still generates high profit margin. Maybe this forecasting method will be more aligned with Kodak's strategy? Some possible methods are discussed in the next chapter as future works.

[15] D&AI Forecast Package December 2001

6.0 FUTURE WORK

My concern is with the future since I plan to spend the rest of my life there.
-- Charles F. Kettering

I left Kodak's D&AI Division at the end of December in 2001. Significant progress has been made since I left the division due to the continued efforts of the enthusiastic team at Kodak. The tool was rolled out in late March to collect April forecasts for the first time. Feedback from the users was collected and issues will be addressed in the Phase II implementation. In this chapter, the incremental improvements to be implemented in Phase II are presented. We also discuss the possible opportunity for using the tool at other divisions at Kodak. And we will continue the discussion started at the end of Chapter Five and propose possible alternative forecast methods.

6.1 Incremental Improvements

The most obvious future work for this project is to improve the current tool by incorporating feedback received from the current users and implementing functionalities planned for Phase II of the project. Please refer to Appendix B and D for the detailed documentations.

Following are major additional features for the Phase II implementation:

- Automatic NRR (Net Realized Revenue) calculation – this will allow a centralized NRR value table to be maintained by the administrator. The result will be major time savings and elimination of possible errors.

- Ability to work off-line – currently, the tool can only be used online and does not allow the forecast spreadsheet to be saved to the local client.

- More flexible catalog number setup function – provides easier navigation during the setup process and allows forecast on future products that do not yet have their catalog numbers established in D&AI Data Warehouse.

- Additional query reports:

  - Actual vs Forecast – provide the actual sales and forecast numbers on the same report. Ratios such as actual sales / forecast and (open order + actual sales) / forecast will be calculated automatically for benchmarking purpose.

  - Individual account report – the query function will return each account forecast individually.

  - Aggregated summary report – the query function will return the summary report.

- An option for all the reports to allow both quantity and revenue to be displayed.

From the survey results, I believe that the tool will increase the productivity for all the users, once the Phase II implementation has been completed.

We can also implement functions to collect more sophisticated data that might improve the forecast accuracy. According to Friedman[16] (LFM 2001), forecasting in a fast life cycle environment may improve with two main additions: Upper and lower limits for the total demand in the market and when the lifecycle of the product begins and ends. Hence, a possible future work to improve the current tool is to implement a system that collects the upper and lower limits, or even, a simple distribution, instead of just a single number.

6.2 Application Across Kodak

It was mentioned earlier in Chapter Three that the initial prototype tool was created after studying a tool having a similar purpose for the Health Imaging (HI) Division. The tool from HI is based on an Excel spreadsheet that requires collecting data manually. For reporting purpose, it contains a pivot table and two pivot charts. Please see Appendix G for the screenshots of the HI Forecasting Tool.

Compared to D&AI, HI has many fewer catalog numbers to forecast and utilizes less account managers. The amount of data contained in the database is relatively small, that is why an Excel-based tool is currently sufficient. However, there are a few reasons why it makes sense to implement the D&AI Forecasting Data Collection Tool:

- As the business expands, the amount of data in the database will grow proportionally. The same problem encountered during the initial prototype testing of the D&AI Forecast Tool would surface, such as sending the spreadsheet, with a large database embedded to the users, would become impractical.

- With large amounts of data, the benefits of time saving from the automation process will become apparent and increasingly important.

- There is no development cost because the software has been already developed. It is ready to be ported to other divisions that have access to a web server and Oracle database.

- The same benefits as described before – standardized format, easily accessible, simple interface, etc.

[16] Friedman, Paul D. "Improvement and Organizational Change When Forecasting Demand in a Short Life Cycle Environment", Master's Thesis, MIT LFM, June 2001.

I feel that it makes a lot of sense to leverage what was developed in the D&AI Division across the whole Kodak organization. Compared to the tool used in HI, the D&AI Forecast Tool offers much more flexibility and capability. While the two divisions have slightly different reporting format (the HI tool has the option of using pivot charts to graphically display the results), HI's tool can be easily adapted into the D&AI Forecast Tool by having an additional query report which contains charts as outputs.

Basic steps toward implementing the tool across other divisions:

- Identify divisions within Kodak that have similar needs for a forecasting data collection tool.
- Benchmark their current processes.
- Verify the software and hardware requirements within those divisions.
- Present the D&AI Forecast Tool to demonstrate the capability and advantages.
- Estimate the cost of the project and present the business case to upper management to achieve buy-ins.

6.3 Different Kinds Of Forecasts?

From the discussion at the end of Chapter Five, an interesting way of forecasting digital cameras would be using the point of sale (POS) data from the retailer level. Currently Kodak collects the POS data from major retailers. However, those data are not being used during the demand forecast process.

Qian Wu (LFM Class of 2001) provided an interesting alternative method of using end-user demand (approximated by POS data, assuming no stockout occurred) to forecast the peak season (week 48 to week 53) demand.[17] She assumed the aggregated demand follows a two-period linear ramp, and the two slopes were obtained from performing linear regressions. The ratio of the two slopes is then used to predict the aggregated demand from other camera lines.

I think the approach described above is an interesting mix of monthly forecasts and aggregated forecasts for the peak season. To steer even further away from the monthly forecast, I thought that we could use the patterns of the POS data from the first few months of launch to estimate the total number of cameras to be sold throughout its lifespan.

The reason that I think POS data is important is because often times the retailers and distributors overreact to volatility. Below are two charts of channel sale-in, retailer purchases, and POS data

[17] Wu, Qian. "A Supply Chain Strategy for Digital Camera Products", Master's Thesis, MIT LFM, June 2001.

from retailers for two different camera models. Product #1 is an older model, while Product #2 is a newer model. As before, absolute numbers are disguised due to confidentiality.

From **Figure 6**, we see that the POS data is very smooth without much volatility, while the channel sale-in (that include both distributor and retailer purchases) is extremely volatile. This bullwhip or whiplash effect is prevalent in value chains across all industries. The demand distortion disconnects the value chain from the customer and inhibits the company's ability to respond quickly.[18]

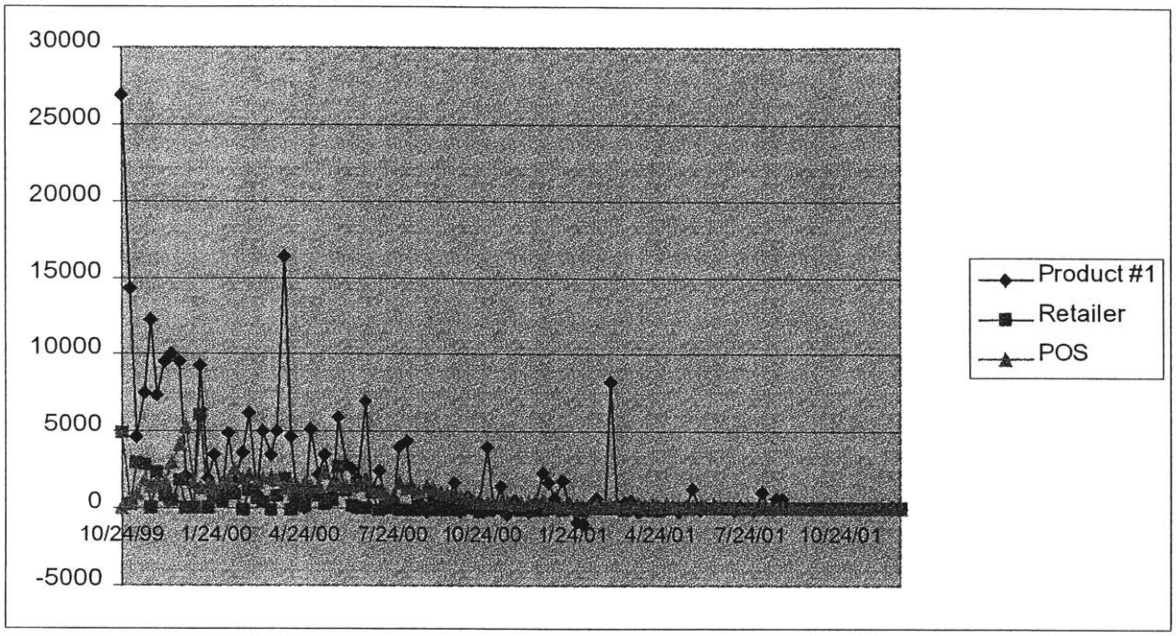


Figure 6: Product #1 Channel Sale-In, Retail Purchases, and POS

Figure 7 has a similar pattern with heavy fluctuation presented to Kodak, while the POS data was relatively smooth without many peaks and valleys. An interesting observation for the Product #2 line is that there is a huge spike near the end and that represent the clearance of inventory by offering very large discount to the retailers. (Which in turn, offers promotions to the end users.) This is exactly what we try to eliminate.

[18] Holweg M. and Pil F. "Successful Build-to-Order Strategies Start With the Customer", *MIT Sloan Management Review*, Vol. 43 No.1 (2001), 74-83.

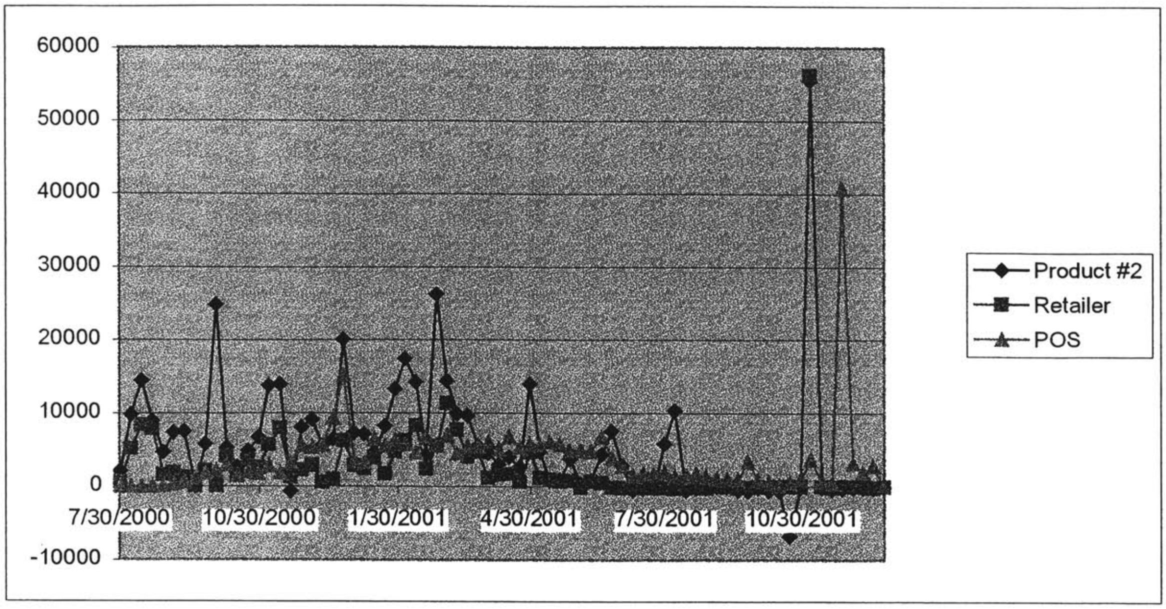


Figure 7: Product #2 Channel Sale-In, Retail Purchases, and POS

There are less data available for the latest line of digital cameras. The first series cameras launched was Product #3. From **Figure 8** below, we see that it exhibits very similar patterns again. (The drop of POS data to 0 at the end is mostly due to the lack of timely data from the retailers at the time of gathering data from the internal Kodak database. Both the channel sale-in and the retailers data were available for that time period, but it is unlikely that the no end-users bought any Product #3 during the Christmas / New Year time frame.)

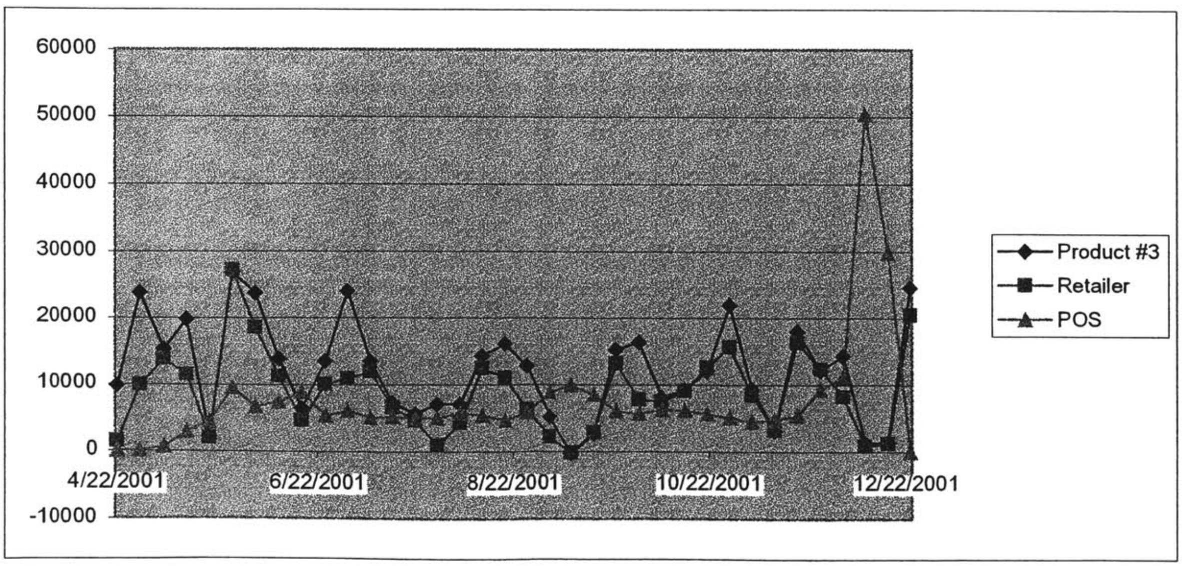


Figure 8: Product #3 Channel Sale-In, Retail Purchases, and POS

The other trend that we see is the fading of distributors. We now see the channel sale-in data follows much more closely with the retailer purchases. At the end of 2001, retailers made up approximately 80% of Kodak sales. In this way Kodak can eliminate the middle party and generate higher profit margins.

From the demand patterns we observed, I felt that the POS data would be better data for forecasting. One of the methods proposed is to use the first few months of POS data (the ramp up rate) to estimate the numbers of cameras to be sold throughout its lifespan. This is assuming the initial reaction from the end-users would forecast the success of the camera line.

The possible problem faced with this method is that it is less flexible to external shocks, for example, an event such as the September 11 terrorism acts. (However, an interesting side note for this statement is that Kodak actually forecasted the demand for the latest line of digital cameras during the Christmas time frame by factoring in the September 11 event. The high demand from the end-users during November and December were unexpected and a lot of sales opportunities were lost.) The reasoning behind this is beyond the scope of this thesis but, surely, would be interesting for future work.

7.0 CONCLUSION

What is this?! There is not a single formula nor computational model in this thing. And you are from MIT and Caltech??
-- Eric Jan, the author of the thesis commenting on his thesis

The implementation of the D&AI Forecasting Data Collection Tool is a process improvement project. It improves the visibility of the data, injects discipline throughout the process, and increases the accountability of the account managers. The standardized web-based tool with a powerful back-end offers significant capability beyond an Excel spreadsheet and allows easy access across the globe with a user-friendly interface.

The reactions from the sales managers, financial, and operations planning personnel were very positive. While the tool is still lacking some functionality to be truly effective for the account managers, the current implementation of the tool is necessary. I consider that to be the growing pain. If we just keep on working on the tool without actually rolling it out, we will face exactly the same situation when the tool is finally implemented. There will always be over-sights and bugs to be fixed during a software development process.

The "multi-step" approach was also designed to ease the transition to move into a forecast accuracy-based incentive system. With the current tool, the account managers' incentive system is tied to the timely usage of the tool. (They have to get the forecast in by the last day of the current month, otherwise the forecast field will be locked and only the administrator will be able to enter the forecast.) In the next phase with the accuracy-tracking matrix in place, their incentive system will be tied to the matrix. By implementing the tool in two different phases, it eases the transition and reduces the resistance from the account managers. The other reason for the multi-steps approach was dictated by the resource constraint.

However, the tool was not designed to fundamentally improve the forecast accuracy. While all the benefits mentioned in the thesis would, in theory, result in better accuracy for having better data, the forecast is still generated subjectively by the account managers through their interaction with the customers.

In Chapter Six, we looked at a few charts that contain demand patterns and channel sales data and it was very striking. What can Kodak do to fundamentally improve the forecast and use the data to run a better supply chain? I feel the need to approach the forecasting problem from a different angle is necessary. Learn how to use the POS data, comparing to the channel sales and retailer ordering data in order to predict channel sales. Look at the major retailers, analyze their order patterns and see if they are rational. Do different stores have different kinds of behaviors? Is there anything that Kodak can do to smooth out the channel sales by working closely with the retailers, for example, show them the POS data to educate them on the over-reacting behavior? How can we allow the account and sales managers to share their reasoning knowledge the market, instead of just a single forecast number?

I feel that there is no magical formula for having a good forecast. Things such as improving the customer relations, achieving stronger ties with the OEM to reduce the long lead-time, practicing DFM (Design For Manufacturing) to increase common components between camera lines, etc., would pay more dividends than investing money in searching for a magical forecast method.

The learning during the internship was remarkable. Looking back to the internship, it was very interesting to analyze the project from the organizational processes aspect rather than simply the technical aspect. For example, I was dumbfounded when I realized that I had to negotiate with people just to add a function to the tool. Being a naïve intern without much business experience, I was wondering – if it was for the good of the company, if the project was ahead of the schedule with the programmer waiting for the next instruction, and if it was a feature that all the account managers want, why on earth did I have to negotiate? I was out of my comfort zone. That is why I felt the internship was a great learning experience. I also realized that sometimes humans are harder to understand than quantum mechanics or partial differential equations!

This is unusual. There is not a single formula nor computational model in this MIT thesis. And I actually enjoyed writing it.

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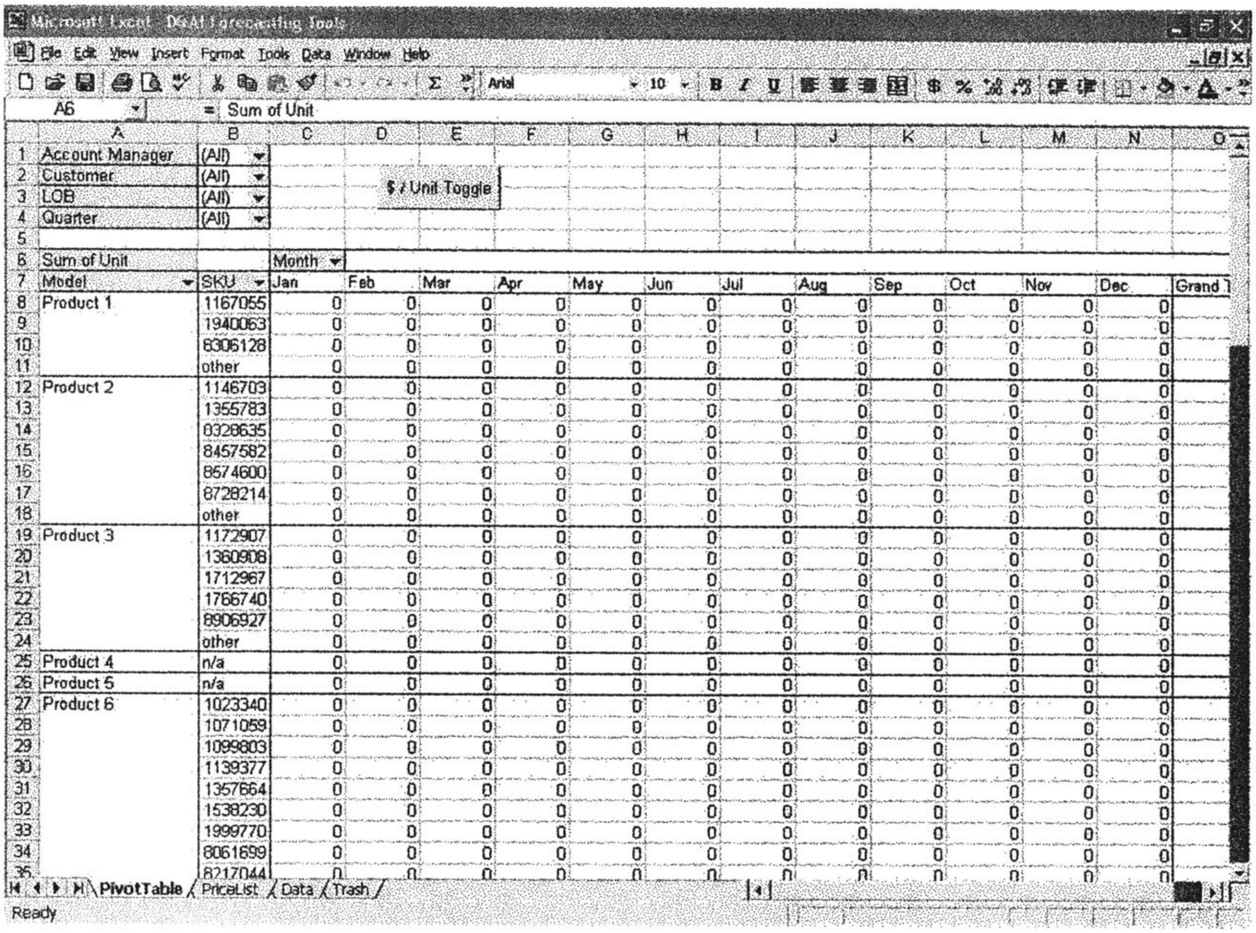
Appendix A: D&AI Forecasting Tool Functional Testing Prototype


Microsoft Excel - D&AI Forecasting Tools

File Edit View Insert Format Tools Data Window Help

A6 = Sum of Unit

Account Manager	(All)
Customer	(All)
LOB	(All)
Quarter	(All)

$ / Unit Toggle

Sum of Unit		Month												
Model	SKU	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand T
Product 1	1167055	0	0	0	0	0	0	0	0	0	0	0	0	
	1940063	0	0	0	0	0	0	0	0	0	0	0	0	
	8306128	0	0	0	0	0	0	0	0	0	0	0	0	
	other	0	0	0	0	0	0	0	0	0	0	0	0	
Product 2	1146703	0	0	0	0	0	0	0	0	0	0	0	0	
	1355783	0	0	0	0	0	0	0	0	0	0	0	0	
	8328635	0	0	0	0	0	0	0	0	0	0	0	0	
	8457582	0	0	0	0	0	0	0	0	0	0	0	0	
	8574600	0	0	0	0	0	0	0	0	0	0	0	0	
	8728214	0	0	0	0	0	0	0	0	0	0	0	0	
	other	0	0	0	0	0	0	0	0	0	0	0	0	
Product 3	1172907	0	0	0	0	0	0	0	0	0	0	0	0	
	1360908	0	0	0	0	0	0	0	0	0	0	0	0	
	1712967	0	0	0	0	0	0	0	0	0	0	0	0	
	1766740	0	0	0	0	0	0	0	0	0	0	0	0	
	8906927	0	0	0	0	0	0	0	0	0	0	0	0	
	other	0	0	0	0	0	0	0	0	0	0	0	0	
Product 4	n/a	0	0	0	0	0	0	0	0	0	0	0	0	
Product 5	n/a	0	0	0	0	0	0	0	0	0	0	0	0	
Product 6	1023340	0	0	0	0	0	0	0	0	0	0	0	0	
	1071059	0	0	0	0	0	0	0	0	0	0	0	0	
	1099803	0	0	0	0	0	0	0	0	0	0	0	0	
	1139377	0	0	0	0	0	0	0	0	0	0	0	0	
	1357664	0	0	0	0	0	0	0	0	0	0	0	0	
	1538230	0	0	0	0	0	0	0	0	0	0	0	0	
	1999770	0	0	0	0	0	0	0	0	0	0	0	0	
	8061699	0	0	0	0	0	0	0	0	0	0	0	0	
	8217044	0	0	0	0	0	0	0	0	0	0	0	0	

PivotTable / PriceList / Data / Trash

Ready

Appendix B: Phase I & II Software Requirements Specification

SOFTWARE REQUIREMENTS SPECIFICATION

Revision Number:	Revision Date:	Revision Person:
1.00	10/19/01	Eric Jan
1.10	11/4/01	Eric Jan

Project ID: D&AI Forecast Data Collection Tool

Project Title: D&AI Forecast Data Collection Tool

Project Description: This task comprises the development of a web-based tool to enable account managers to enter monthly forecast numbers with a familiar interface (similar to that of the D&AI Data Warehouse) via Kodak's intranet. The format will be standardized, thus eliminates the need for the sales managers to perform aggregation of forecast numbers from multiple account managers. The tool will also provide a gateway for next phase implementation of forecast tracking, which will allow the improvements in production forecast and the incentive system.

Version: 1.00

Created: 10/19/01 9:30 AM by Eric Jan

Project Lead – Technical:

Executive Summary: The functionalities of the tool will be used to support the process of collecting monthly forecast numbers from the account manager and provide an easier and more accurate way for the sales managers to communicate the forecast to the production / operation group.

The business case of this project is in:

- More accurate forecast for production (forecast in units, instead of revenue, which is what the account managers' incentives are tied to currently). With more accurate forecast, we can improve chance of eliminating the possibilities of stock out and excessive inventory.
- Easy access for the account managers will increase the participation in providing forecasting. Time will be saved from the simplified process.
- Allowing tracking (in next phase implementation) of forecast accuracy. An improved incentive system can be implemented accordingly to enhance the result.
- Providing a stronger basis when negotiating for the final production numbers via easy access to aggregated data across the board. Eliminate garbage-in, garbage-out situation.
- Bottom line saving: D&AI division had $xxx million dollars worth of inventory in year 2000. According to the analysis performed by Earnest William, every percentage point in forecast improvement will result roughly $Y million dollars.

D&AI is continuously improving the efficiency of the supply chain. In year 2001, the inventory had been reduced to roughly $ZZZ million dollars. With the implementation of this tool, we hope to further reduce the inventory and result in higher profit.

Functional Requirements:

- **Account Maintenance Function:**
    - Administrator will be able to assign accounts (w/ **corporate customer #**) to account managers. (i.e., link account manager 1 with account A, B, and C.) **This function already exists in the D&AI Date Warehouse.**

- **Account Cat Number and Forecast Maintenance Functions:**
    - Drop down menu for the account manager to select a particular account. The menu will only consist of accounts that he/she is responsible for.
    - Account sharing (one account associates to multiple account managers) policy is per current D&AI Data Warehouse setup. For example, if two account managers are associated to one account, both account managers will be able to change the cat # set associated to that particular account. They will also be able to change the forecast #s.
    - A setup page for the account manager to type their own set of cat #s for the input sheet. Ability to select the account, and then choose what cat #s (from the master list in the PRODUCT table) to be used in the input sheet. The application will then automatically display the Product description and audit that the catalog number is in the database. If the catalog number is not in the database and error message will ensue and the catalog number entered will not be saved.
    - Forecast #s for next month will be locked up at the end of this month. (For example, in October, account managers are supposed to enter the set of forecast #s for November, which include #s for November, December and so on. The November #s will be locked on November 1st.) The account manager will be presented with current month out to 12 months and will be unable to update current and past months by design.
    - A matrix to be filled with forecast # (in units, maximum of 5 digits) and revenue (in dollars, maximum of 8 digits) with axis made of pre-determined cat #s (selected in the account setup page) and months.
    - Changes in forecast #s will be recorded with time stamp in a **history table**. This will allow the users to track the forecast progress in the future when the interface for viewing is implemented in the next phase.
    - A "Submit" button to submit the inputs into the D&AI Data Warehouse with a warning message (such as "Select "Yes" will submit your #s to the database").

- **Filter / Sort Features:**
    - For viewing the aggregate data.
    - First select the **Beginning Month / Year**, default setting will be current month.
    - Drop down menus on "**Region**" (using **Customer Set Code**), "**Account Manager**", "**Account**", "**LOB**", (Ex. Inkjet, DC), and **Cat #**.
    - Account Manager and Account are connected. For example, if you select account manager A in the Account Manager Menu, only accounts which account manager A is responsible for will appear on the Account Menu. (Hierarchy in the given order.)
    - Once all the filtering criteria are chosen, one will need to select file type and report type (see next section), then submit the query by clicking on "Submit".

- **Query Output Page:**
    - The output file will consist of two formats: Either as a **PDF** (Portable Document Format) file or an **Excel** spreadsheet. The user will have the option to choose the output format before submit for the query. PDF output will show **6 months** of forecast, while Excel output will show **12 months**.
    - There will be 2 types of report:
        1. **Unit** summary sheet – which shows the monthly and quarterly aggregated number of units by cat #.
        2. **Revenue** summary sheet – which is similar to the unit summary sheet except it shows the aggregated net realized revenue.

- **Security Requirements:**
    - Per D&AI Data Warehouse regulation. Each user will have access only to his or her pre-determined selection of "transactions" – Security modeled in Key Account Reports where Sales Managers can see all accounts (ex. For sales manager 1.)

- **LOB Requirements:**

  - LOBs that will be initially used for this application are 04C (Inkjet) and 0GL (cameras). Capability will be provided to allow programmer to add and delete LOBs without the need to change any code.

Sample Output:

Monthly Forecast for the Next 6 Months

Account Manager 1
Account 1

	1/01	2/01	3/01	4/01	5/01	6/01	Q1/01	Q2/01	Q3/01	Q4/01
Accessories										
cat # description										
Total Accessories										
DC										
cat # description										
Total DC										
Total (revenue only)										

Account 2

	1/01	2/01	3/01	4/01	5/01	6/01	Q1/01	Q2/01	Q3/01	Q4/01
Accessories										
cat # description										
Total Accessories										
DC										
cat # description										
Total DC										
Total (revenue only)										

Account Manager 2
Account 1

	1/01	2/01	3/01	4/01	5/01	6/01	Q1/01	Q2/01	Q3/01	Q4/01
Accessories										
cat # description										
Total Accessories										
DC										
cat # description										
Total DC										
Total (revenue only)										

Total (revenue only)										

* Quarterly #s are the actual quarterly #, meaning Q1 = Jan. + Feb. + Mar.

SOFTWARE REQUIREMENTS SPECIFICATION

Revision Number:	Revision Date:	Revision Person:
1.00	11/07/01	Eric Jan
1.10	12/19/01	Eric Jan

Project ID: D&AI Forecast Data Accuracy Tracking Tool

Project Title: D&AI Forecast Data Accuracy Tracking Tool

Project Description: This task comprises the development of a web-based tool to enable the users to track monthly forecast accuracy with a familiar interface (similar to that of the D&AI Data Warehouse) via Kodak's intranet. Several additional reports will be added to the forecasting tool that currently exists. It will be the continuation of the D&AI Forecasting Tool Phase I implementation.

Version: 1.00

Created: 11/07/01 3:00 PM by Eric Jan

Project Lead – Technical:

Executive Summary: The functionalities of the tool will be used to keep track of monthly forecast accuracy from the account manager and provide an objective measurement of accuracy to inject more credibility to the forecast numbers. Proper incentive system will be tied to the forecast accuracy.

The business case of this project is in:

- More accurate forecast for production (forecast in units, instead of revenue, which is what the account managers' incentives are tied to currently). With more accurate forecast, we can improve chance of eliminating the possibilities of stock out and excessive inventory.
- Easy access for the forecast accuracy will result in more visibility and credibility for the demand forecast from the account managers.
- Allowing tracking of forecast accuracy. An improved incentive system can be implemented accordingly to enhance the result.
- Providing a stronger basis when negotiating for the final production numbers via easy access to aggregated data across the board. Eliminate garbage-in, garbage-out situation.
- Bottom line saving: D&AI division had $XXX million dollars worth of inventory in year 2000. According to the analysis performed by Earnest William, every percentage point in forecast improvement will result roughly $Y million dollars.

D&AI is continuously improving the efficiency of the supply chain. In year 2001, the inventory had been reduced to roughly $ZZZ million dollars. With the implementation of this tool, we hope to further reduce the inventory and result in higher profit.

Functional Requirements: (Additional to the Phase I requirement)

- **Account Cat Number and Forecast Maintenance Functions:**

  - Easier way for selecting catalog numbers during the account setup function. Instead of entering catalog numbers manually, the account managers can follow a hierarchy of **key product category, key product**, and then **catalog numbers** (with description). The users can then select the desired catalog numbers by highlight the selection.

  - In the forecast Excel spreadsheet, dynamically provide **sub-totals** for each product line and a grand total for each month.

  - **Automatic Revenue Calculation** - within the forecast maintenance function, the revenue value will be automatically populated by multiplying the quantity value to a pre-determined unit price / NRR value. The values might be uniformed across every account, but it might also be different according to each account. This has yet to be determined. The unit price / NRR value will need to be updated constantly. The change in value should not affect past forecasts.

- **Query Output Page:**

  - A choice of **individual account report** or **aggregated summary report**. If individual report was selected, the query function will return each account forecast individually. (1 account per sheet.) If the aggregated summary report is selected, the function will return a summary report, which is similar in format to the regular individual report, except it will contain catalog numbers from all selected accounts and the sum from every accounts.

  - **Additional Reports:**

    - **Monthly Sales to Forecast Result**

      - In this report, it should contain the following information: For each month, it should have current month forecast, open orders, actual sales. Two accuracy measures will be defined.

        - Actual Sales / Forecast

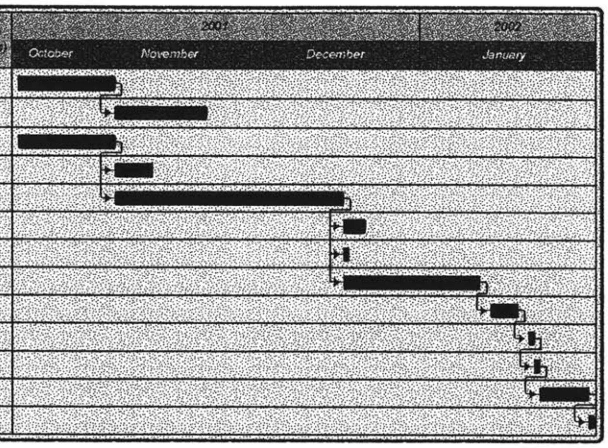
        - (Open Order + Actual Sales) / Forecast

    - A report option which contains both **quantity** and **revenue** on the same sheet. (In Phase I, there's two separate reports for quantity and revenue.) Due to the physical limitation on the printer output, **6 months** of forecast will be shown on this report, instead of the current setup of 12 months.

Appendix C: D&AI Forecasting Tool Implementation Time Line

D&AI Forecasting Tool Implementation Time Line

Task Name	*ID*	*Start Date*	*End Date*	*Duration (workdays)*
D&AI Forecasting Tool Phase I Software Specification	1	10/19/2001	11/5/2001	12d
D&AI Forecasting Tool Phase II Software Specification	2	11/6/2001	11/22/2001	13d
Phase I - Cat # Maintenance Function	3	10/19/2001	11/5/2001	12d
Code Review	4	11/6/2001	11/12/2001	5d
Phase I - Forecast # Input Function	5	11/6/2001	12/17/2001	30d
Code Review	6	12/18/2001	12/21/2001	4d
Forecast # Input Prototype Reviewt	7	12/18/2001	12/18/2001	1d
Phase I - Query / Report Function	8	12/18/2001	1/11/2002	19d
Code Review	9	1/14/2002	1/18/2002	5d
Complete Phase I Review	10	1/21/2002	1/21/2002	1d
Account Managers Training	11	1/22/2002	1/22/2002	1d
Phase I Tool Used For The First Time	12	1/23/2002	1/31/2002	7d
Review First Month Implementation Results	13	2/1/2002	2/1/2002	1d



Appendix D: Final Phase II Functional Requirements

Forecasting Requirements – Phase II Draft 4/10/02

Spreadsheet Issues

I. NRR Calculations

This would enable the NRR to be calculated automatically.

Currently the Account Managers need to do this on a separate spreadsheet and then drop those numbers again into the Forecast Tool, thus creating a duplicate effort. A financial person would update the NRR table in the Warehouse once each month.

II. Ability to save the Forecast Spreadsheet to the hard drive and print the spreadsheet. This has been requested by the Account Mgrs. This would be useful for them to have the ability to also work offline and then copy/paste the cells into the tool as needed. This also enables them to override the NRR by customer, if needed. They would like the portability of having these at their fingertips when visiting their accounts and for marketing reporting.

III. The ability to forecast future catalog numbers. This may not be feasible at this time. The catalog numbers cannot be used in the Forecasting Tool until they are set up in the D&AI Warehouse master data. There is currently a procedure, led by the WW Planning Team to set-up the catalog numbers and input them into the Warehouse as soon as possible, however the Account Managers sometimes need to forecast these items further out.

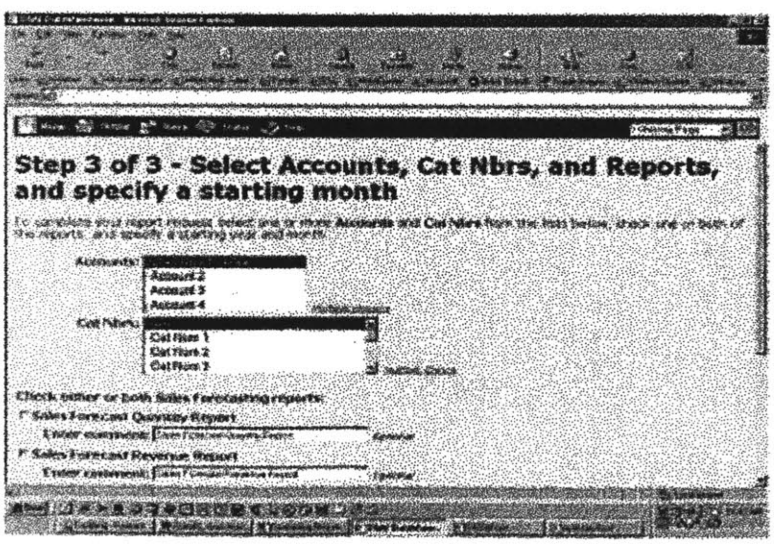
Sales Forecast Reports Issues

I. Increase the 1000 character parameter constraint when creating a report. Often a report will need to be run in pieces and then merged within excel. This increases the margin for error and is very time consuming. Brenda Delyser is aware of this constraint.

II. Reporting ability to run a report that compares the actual vs. the forecast, by account. This is a much-wanted report that the Account Managers are requesting for benchmarking, and account management purposes.

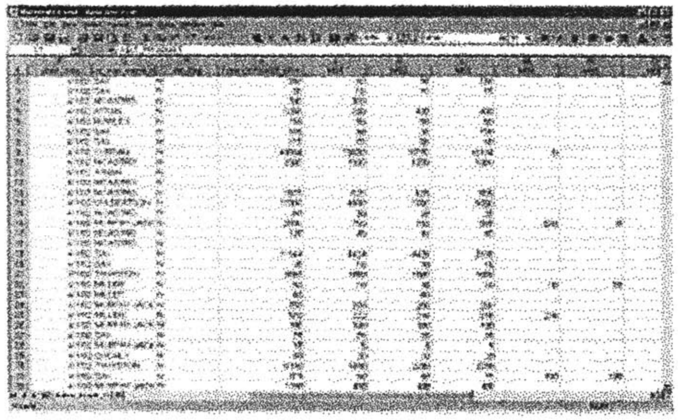
III. The ability to query the tool and save the report as a "canned" report. This would allow management to set up predetermined monthly reports and run them as needed. For example: Sales Manager 1 would like a report set up that already includes all her Account Managers and their respective accounts. The report would also show both units and revenue by account, summarized by account, Account Manager, and a grand total. The report would only need to changed if any of the Acct Mgrs switched accts or a new Acct Mgr comes on board or leaves.

IV. Request by all Account Managers and Finance to run reports that includes both units and revenue on the same spreadsheet. This could also include the forecast vs. the actual as stated above request II.

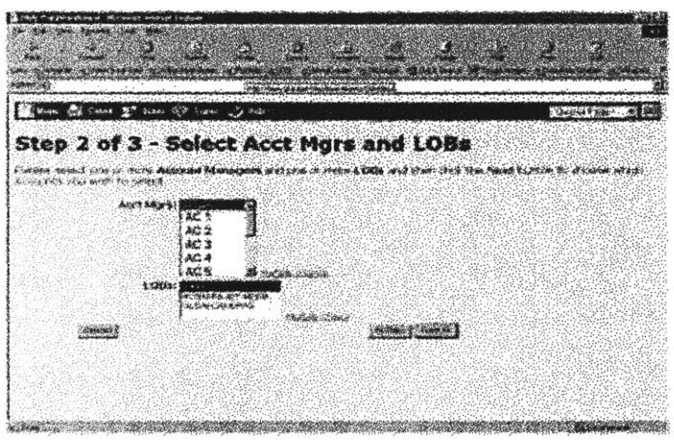


V. The ability to sum the forecasts by quarter, ½ year, as well as by month. This will also be used for benchmarking purposes.

VI. When viewing a report we need to see the actual month each forecast is for. Columns J, K, and L, etc (see below) just state M01, M02, etc. This can be very confusing when saving these reports. Month 01, is always the current (next) month, but may also be thought of as January, etc. The actual month name must be in this field.

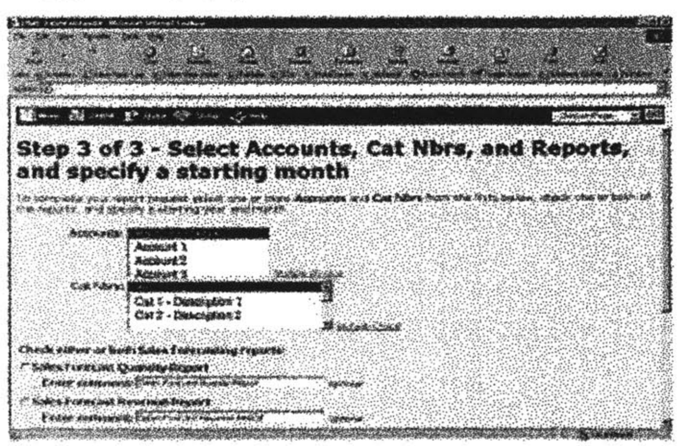


VII. For reporting purposes it is vital that we have another drop-box added on "Step 2 of 3" below the LOB selection (see below). This drop-box would list the option of "Category Key Product", and the choices would be DC, Inkjet, and Accessories. The reports currently show this field and we need to be able to select it as an option. For example: We need to run a report just for Accessories. The title of the page would change to: Step 2 of 3 – Select Acct Mgrs, LOBs, and Key Product Categories".

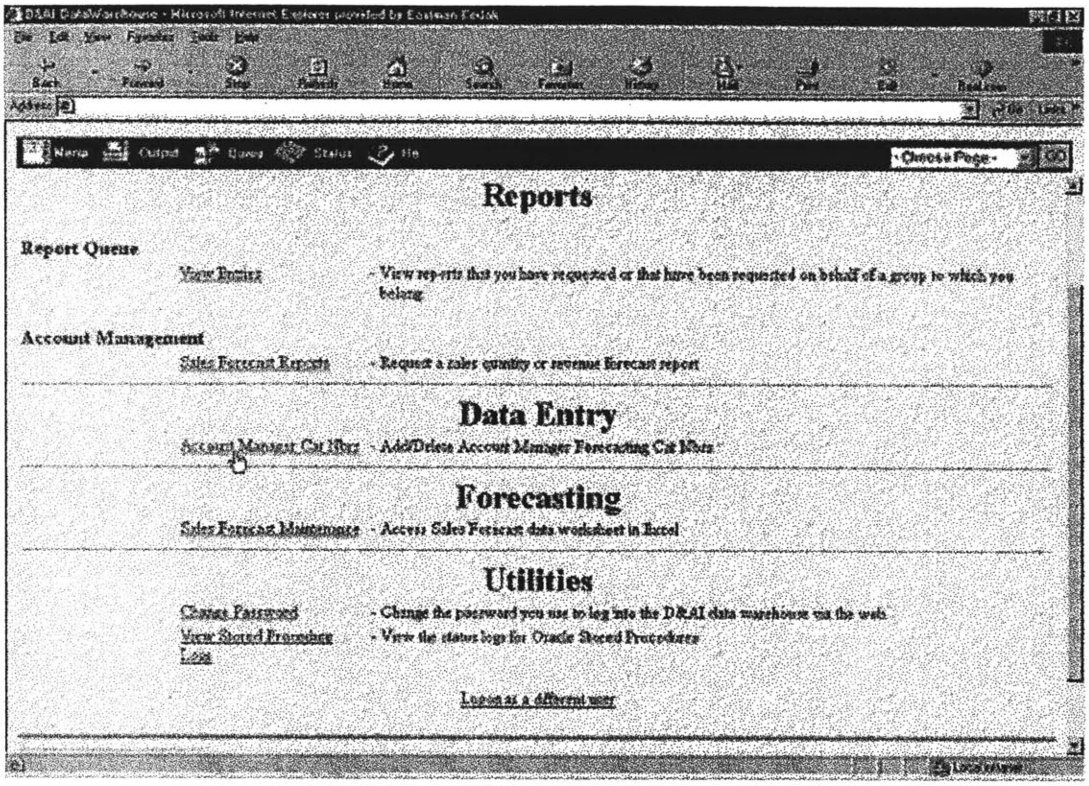


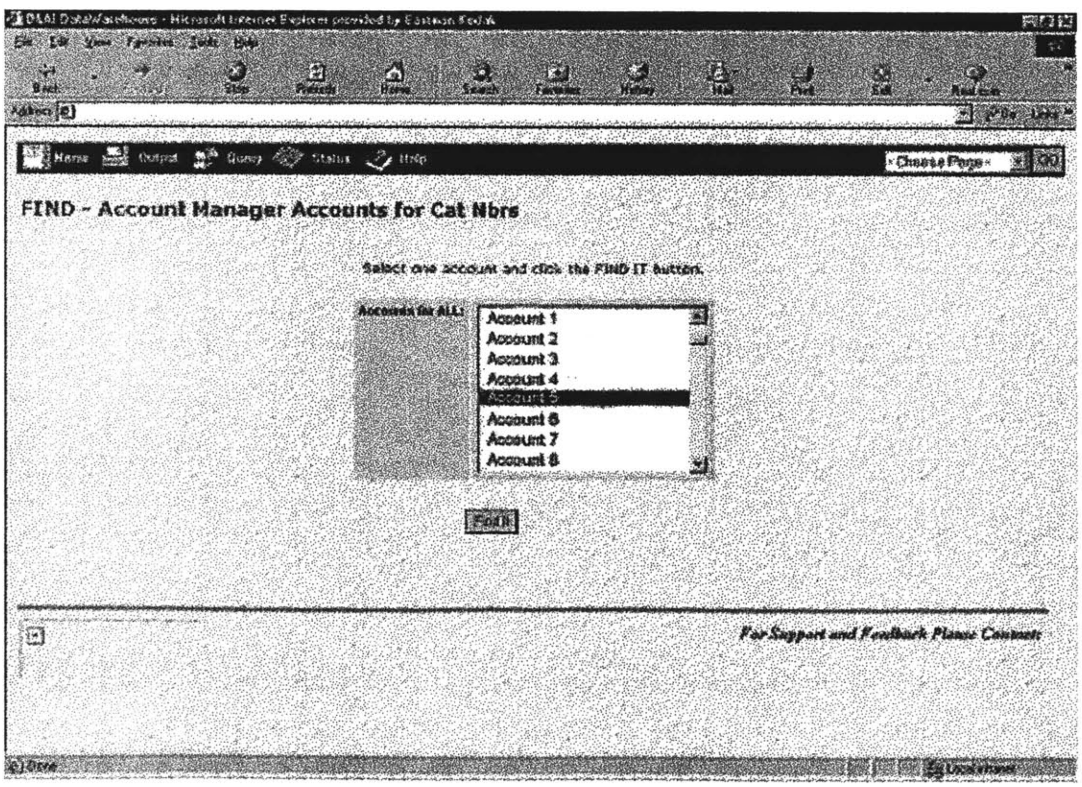
VIII In step 2 of 3 (see above screen print again) we need to include the option of selecting -ALL- Account Managers just as we can for LOB.

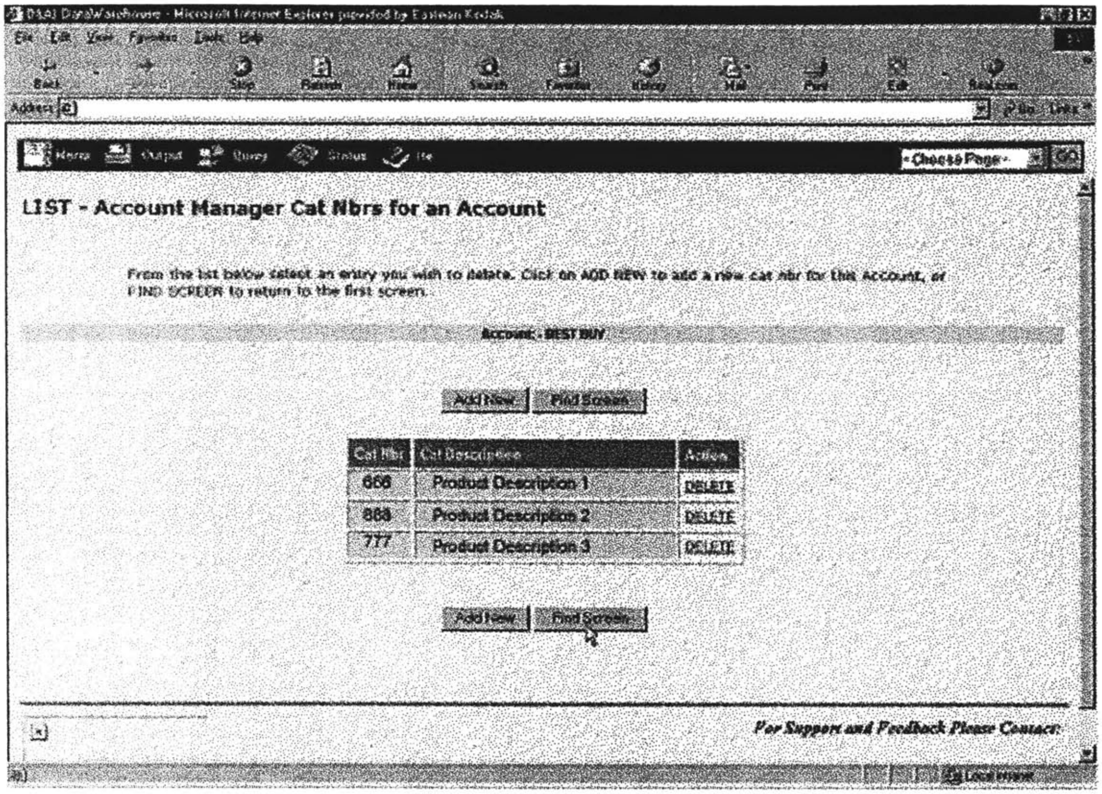
IX. In Step 3 of 3 (see below screen print) we need to include the option of selecting -ALL- Accounts just as we can for Cat Nbrs.

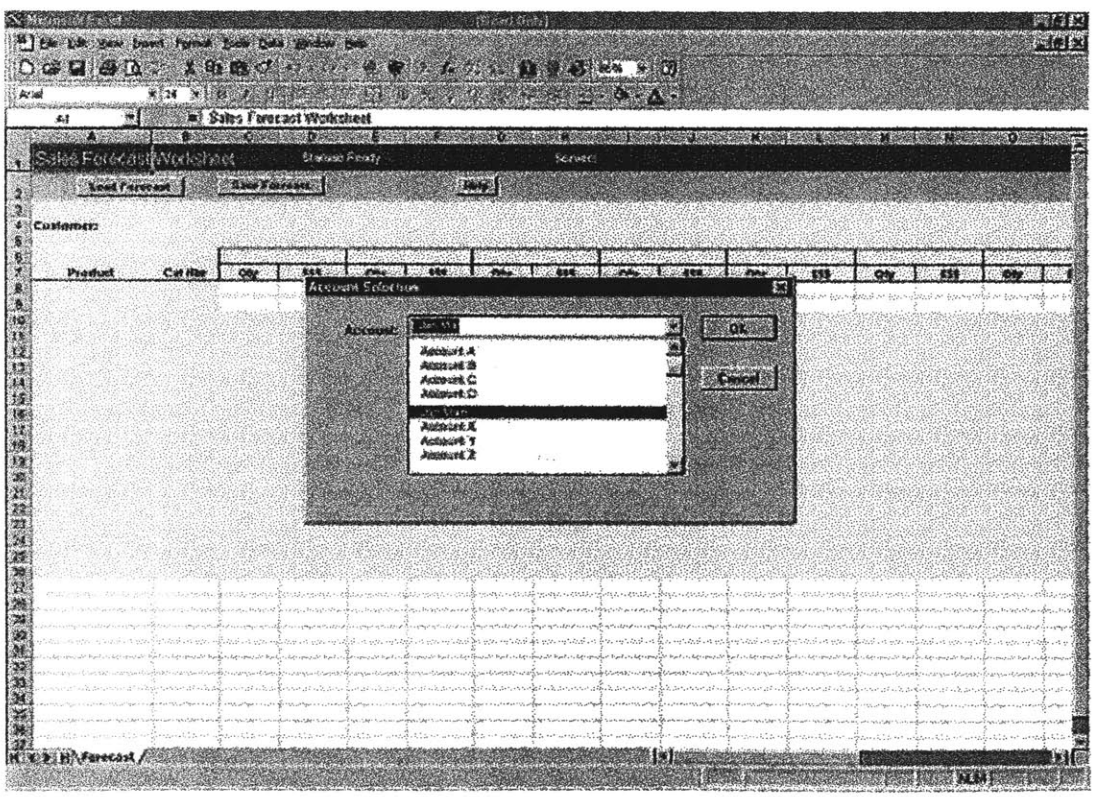


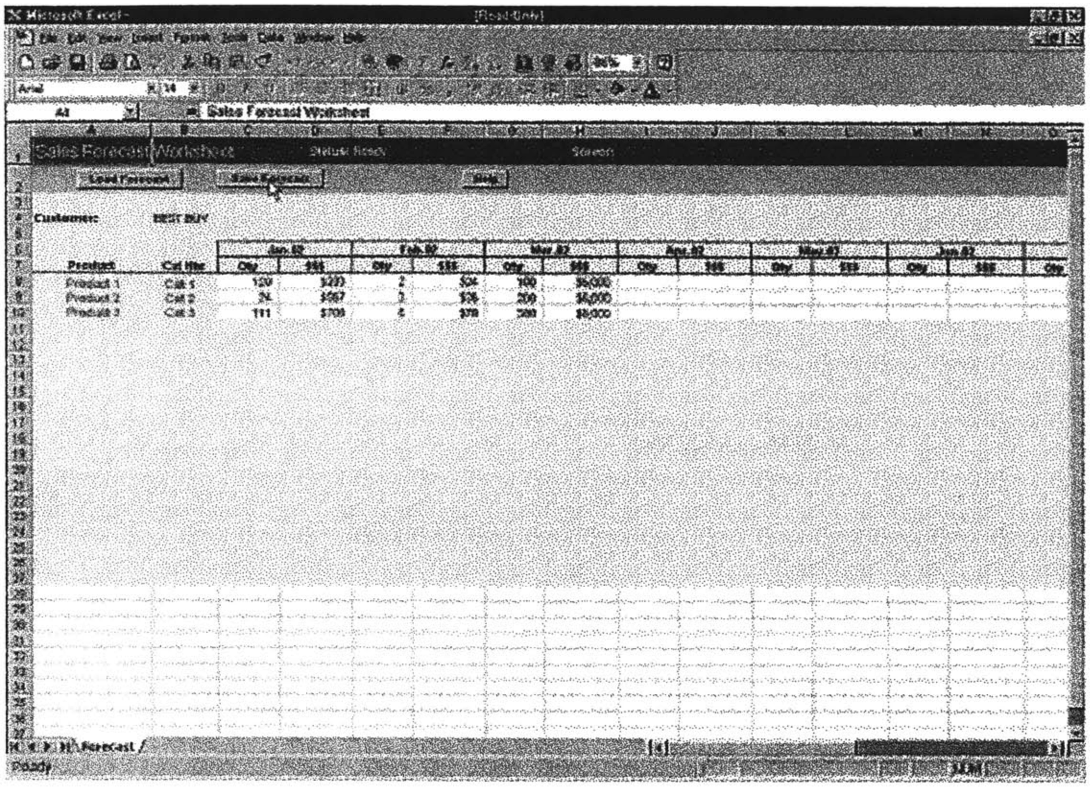
Appendix E: Selected Screenshots Of D&AI Forecasting Tool

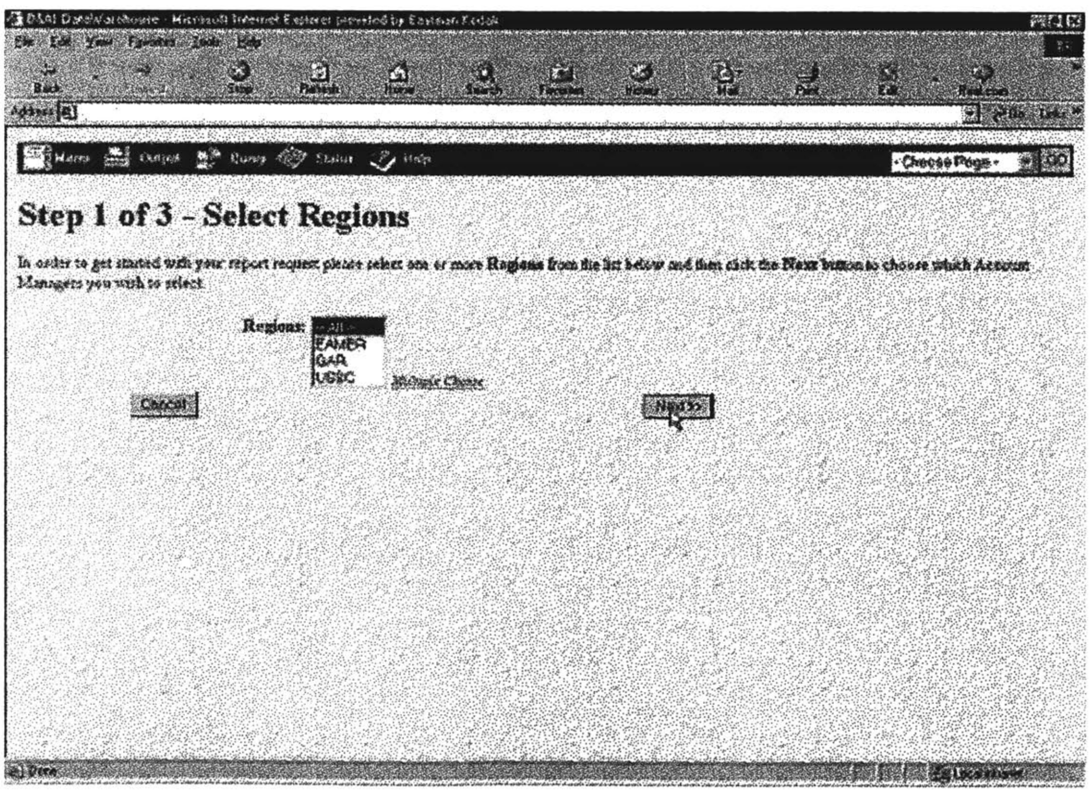


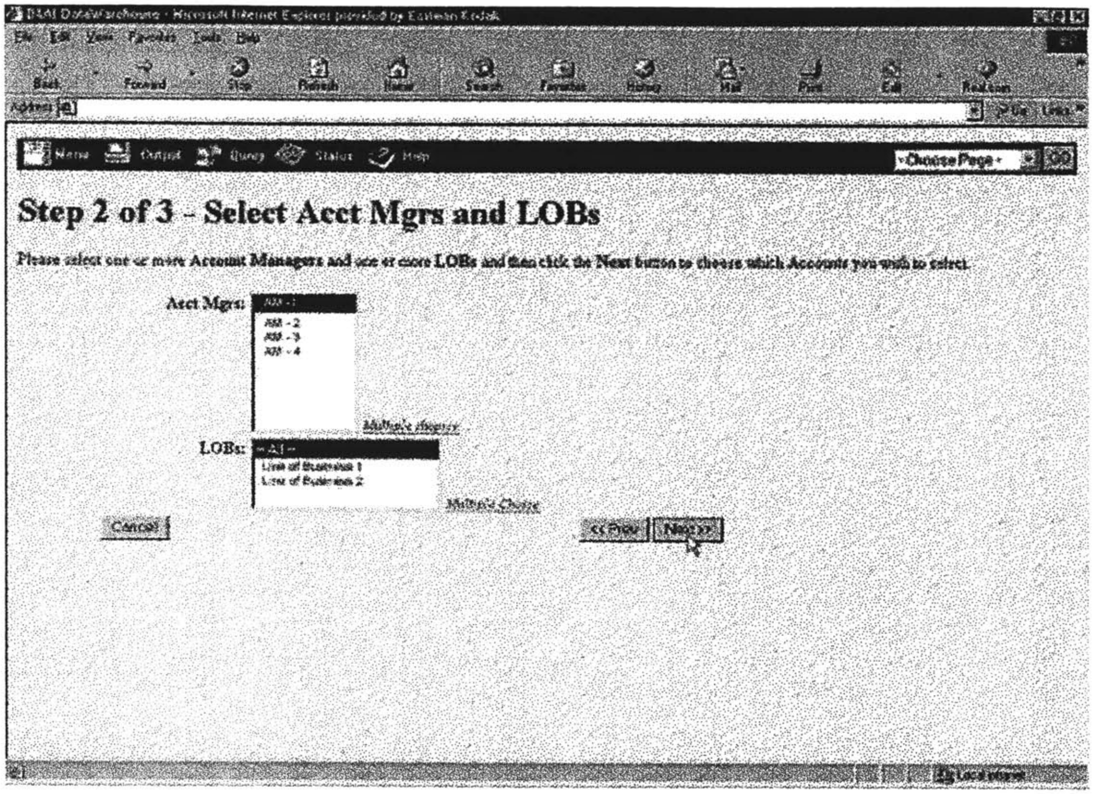



LIST - Account Manager Cat Nbrs for an Account
From the list below select an entry you wish to delete. Click on ADD NEW to add a new cat nbr for this Account, or FIND SCREEN to return to the first screen.
Account: - BEST BUY
Add New
Find Screen
Cat Nbr
Cat Description
Action
666
Product Description 1
DELETE
888
Product Description 2
DELETE
777
Product Description 3
DELETE
For Support and Feedback Please Contact:

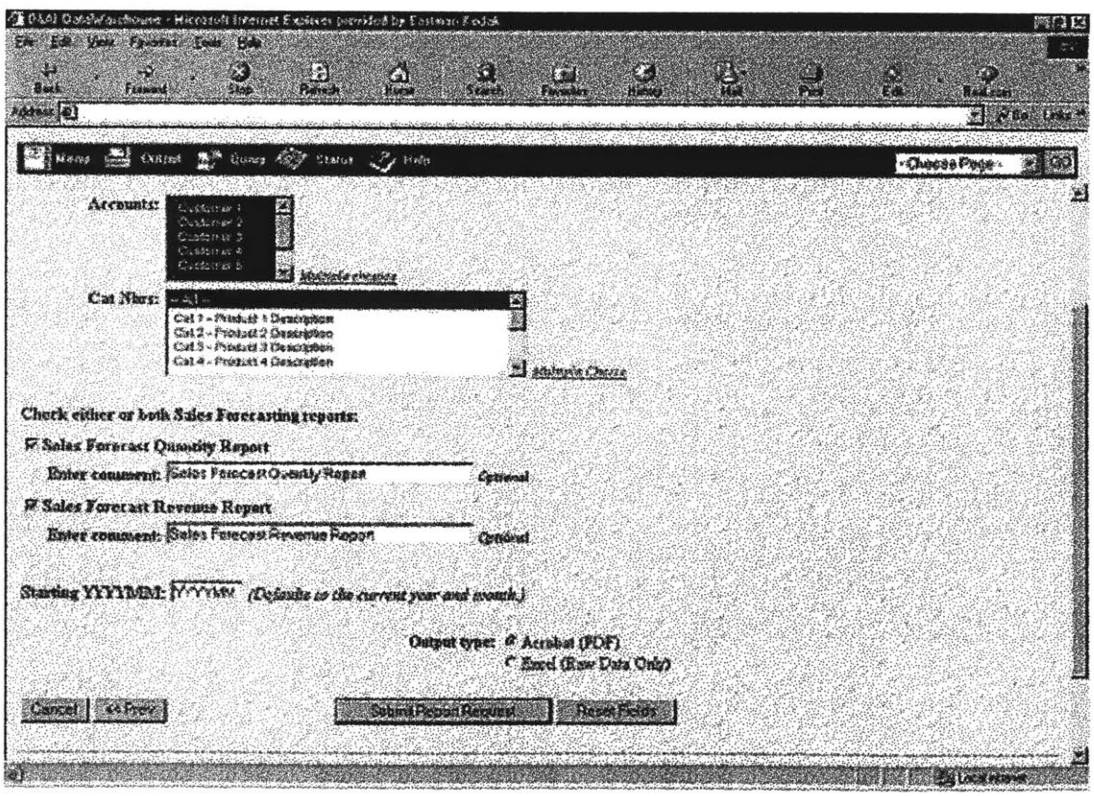

Sales Forecast Worksheet
Load Forecast
Save Forecast
Help
Customer:
Product
Cat Nbr
Qty
$$$
Account Selection
Account:
Ok
Cancel
Account A
Account B
Account C
Account D
Account X
Account Y
Account Z
Forecast


Sales Forecast Worksheet
Customer:
BEST BUY
Product
Product 1
Product 2
Product 3

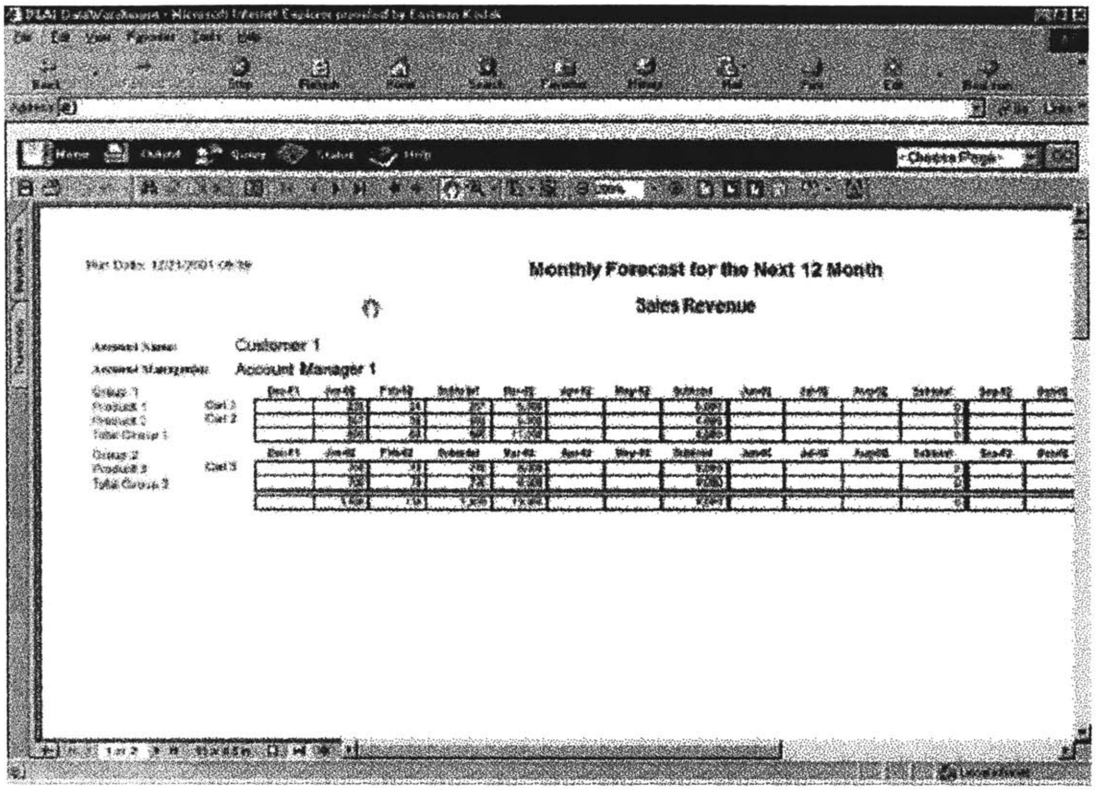

Step 1 of 3 - Select Regions
Regions:
EAMER
GAR
USSC
Cancel

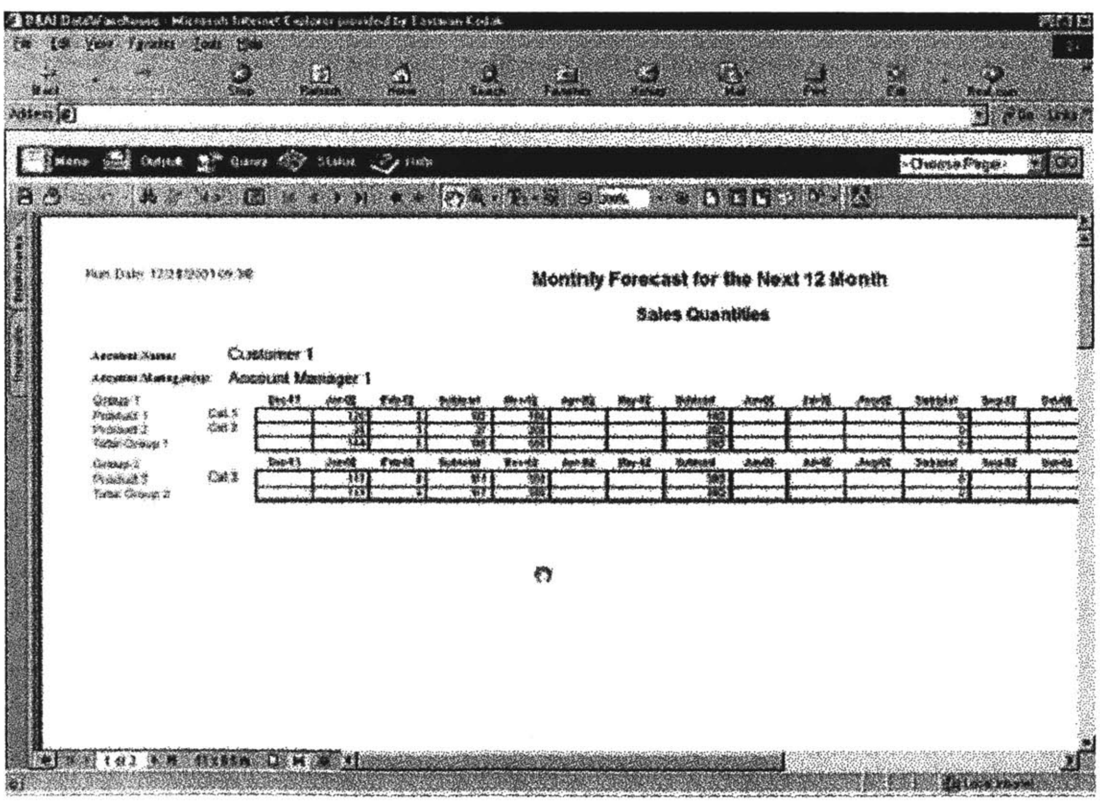


Step 2 of 3 - Select Acct Mgrs and LOBs
Please select one or more Account Managers and one or more LOBs and then click the Next button to choose which Accounts you wish to select.
Acct Mgrs:
LOBs:
Cancel
<< Prev
Next >>



Accounts:
Cat Nbrs:
Check either or both Sales Forecasting reports:
Sales Forecast Quantity Report
Enter comment:
Optional
Sales Forecast Revenue Report
Enter comment:
Optional
Starting YYYYMM:
(Defaults to the current year and month.)
Output type:
Acrobat (PDF)
Excel (Raw Data Only)
Cancel
Submit Report Request
Reset Fields


Monthly Forecast for the Next 12 Month
Sales Revenue
Customer 1
Account Manager 1


Monthly Forecast for the Next 12 Month
Sales Quantities
Customer 1
Account Manager 1

Appendix F: D&AI Forecasting Data Collection Tool Survey

D&AI Forecasting Data Collection Tool Survey

* Thank you very much for taking the time to respond to the survey. Feel free to elaborate on your answers. (Use as much space you wish!) Your responses will be strictly confidential and the aggregated results are for academic research purpose only. The survey should not take longer than 5-10 minutes of your time.

1. Has the new forecast tool made your monthly forecasting process easier?

a. Not at all
b. Somewhat
c. Yes
d. Very Much

If yes, how? If not, why not? ______________________

2. Does the new tool save time?

a. Not at all
b. Somewhat
c. Yes
d. Very Much

If yes, how much time? If not, why not? ______________________

3. What are the benefits of the current tool compared to the old one?

____

4. Knowing that the Phase II tool will be built with the feedback collected from using the current tool, do you think the Phase I implementation (the current tool) is necessary?

a. Not at all
b. Somewhat
c. Yes
d. Very Much

Why or why not? ______________________

5. Will the Phase II tool be much more useful?

a. Not at all
b. Somewhat
c. Yes
d. Very Much

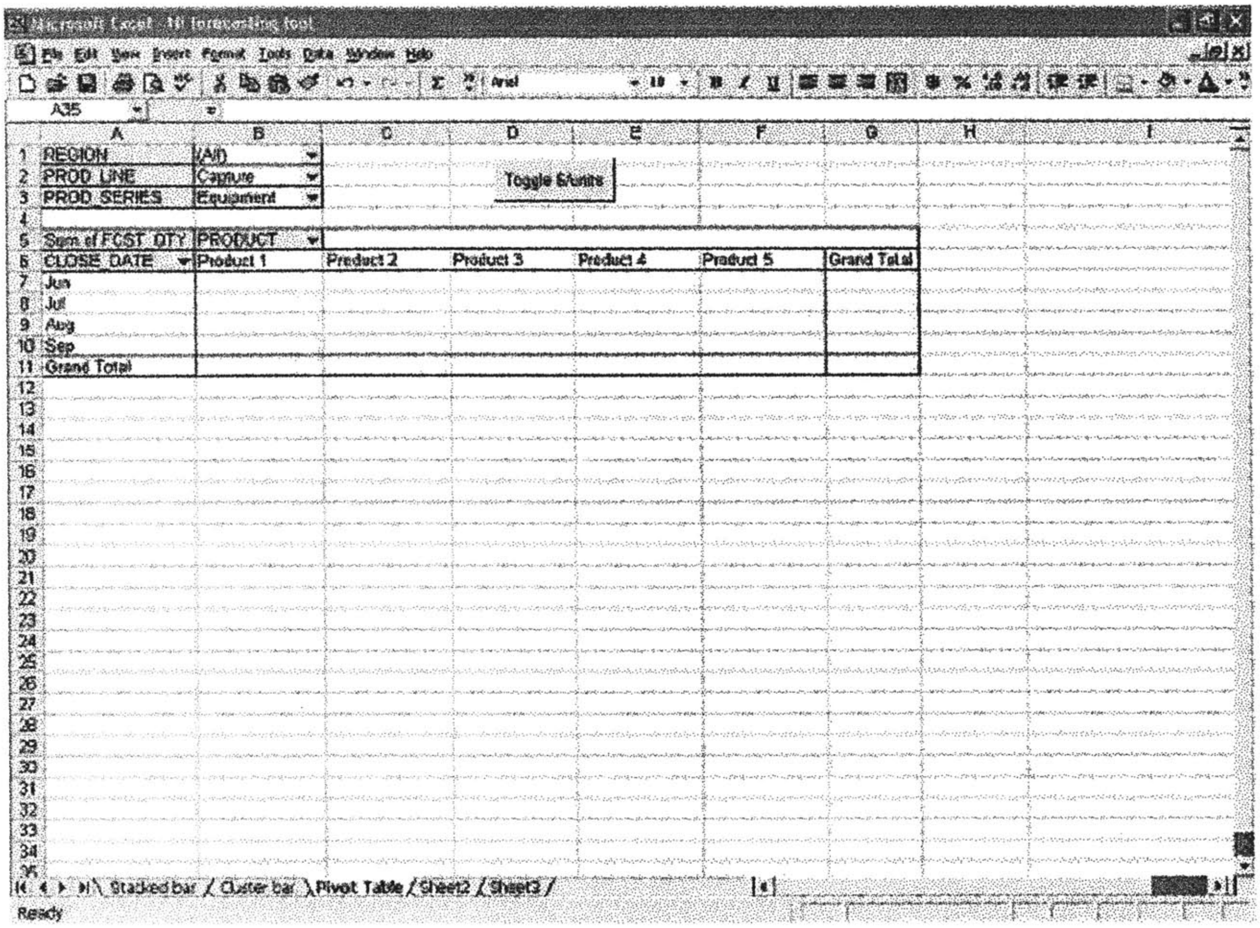
Why or why not? ______________________

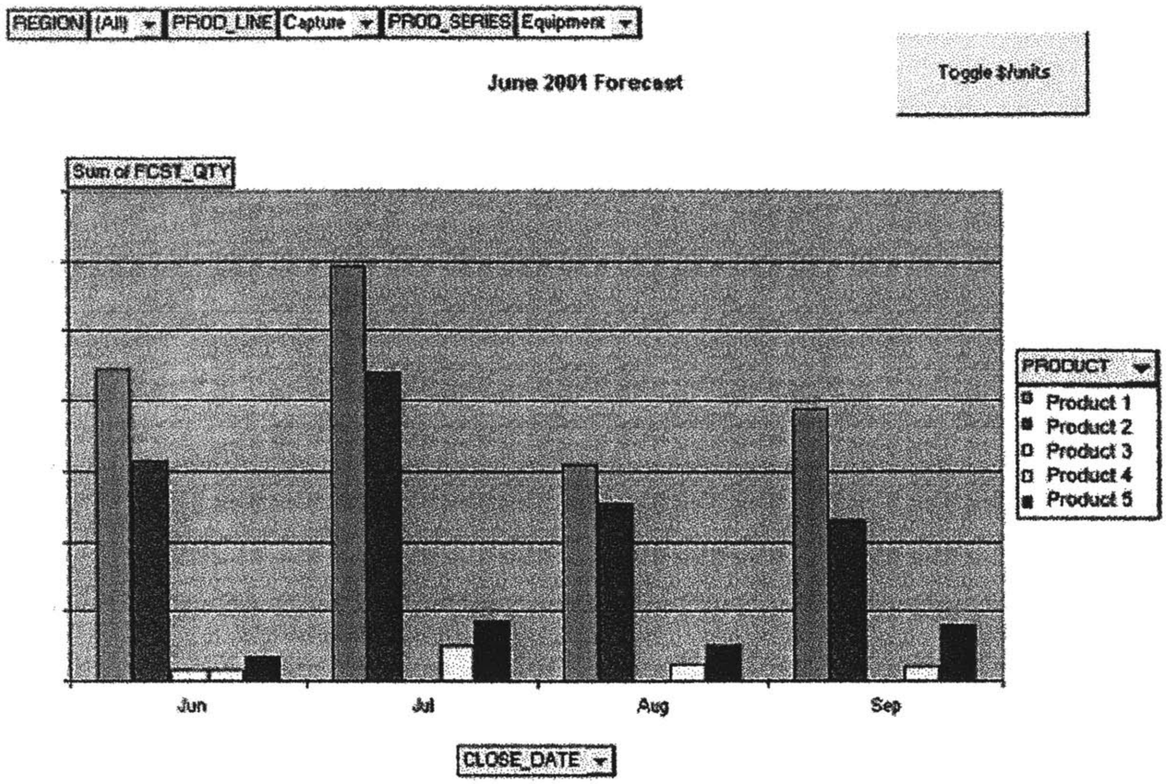
6. Do you think the implementation of a web-based, standardized tool in general is the right way to go in the future?

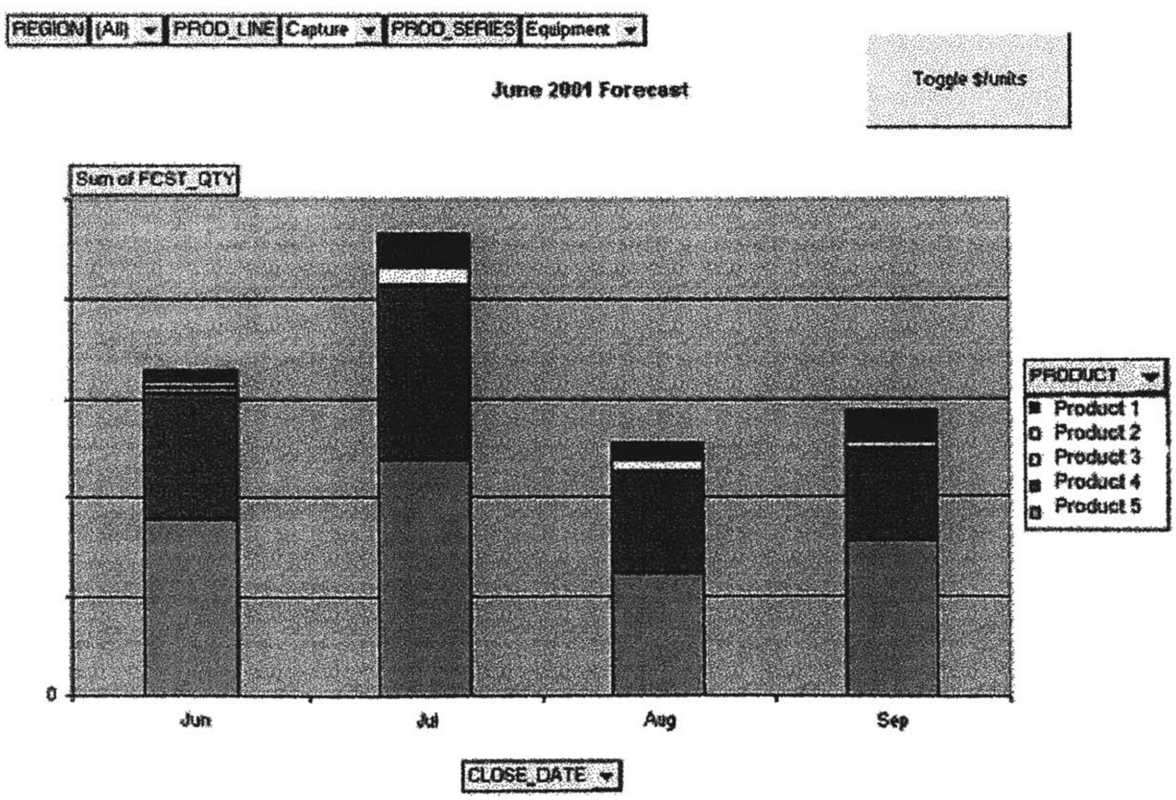
a. Not at all
b. Somewhat
c. Yes
d. Very Much

Why or why not? ______________________

Appendix G: Kodak Health Imaging Forecasting Tool




REGION (All)
PROD_LINE Capture
PROD_SERIES Equipment
June 2001 Forecast
Toggle $/units
Sum of FCST_QTY
PRODUCT
Product 1
Product 2
Product 3
Product 4
Product 5
Jun
Jul
Aug
Sep
CLOSE_DATE


REGION (All)
PROD_LINE Capture
PROD_SERIES Equipment
June 2001 Forecast
Toggle $/units
Sum of FCST_QTY
PRODUCT
Product 1
Product 2
Product 3
Product 4
Product 5
0
Jun
Jul
Aug
Sep
CLOSE_DATE

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