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SIMULATION CASE STUDIES IN THE PRINT / FINISH INDUSTRY

Tim Curran
D. Michelle Benjamin

Textile/Clothing Technology Corporation
211 Gregson Drive
Cary, North Carolina 27511, U.S.A.

Sue Austin

Bell & Howell Mail Processing Systems Co.
4401 Silicon Drive
Durham, North Carolina 27709, U.S.A.

ABSTRACT

Process simulation is a powerful analysis tool used in many industries. It allows companies to be proactive in determining what strategies will be successful. For this reason, manufacturing companies have incorporated simulation models into their decision-making processes for years. However, many industries have not taken full advantage of process simulation. One industry facing problems similar to manufacturing is the print/finish industry. Because of similarities to the manufacturing world, we have been able to use simulation to help companies in the print/finish industry address the problem of how to get more volume through the system in a shorter amount of time. This paper discusses two particular cases in which simulation was used to solve these problems under differing circumstances.

1 INTRODUCTION

Process simulation is used successfully in a variety of industries. The most common of these industries are the automotive, airline and health care industries. However, there are many companies in other industries that are beginning to notice the enormous gains to be made through the use of process simulation. One industry similar to manufacturing that is benefiting from simulation is the print / finish industry.

As consumers, we get our bills and banking/investment statements every month, but we never stop to think about the processes involved in transforming these statements from records in a database to sealed envelopes arriving at our doors. This cycle begins with a database which stores statement information for each individual account. When the statement period is closed, the information goes from the database to a print queue. In some facilities, the database sorts this information by zip code for postage reductions before releasing it to the print queue. This minimizes the manual scheduling of jobs on the mail room floor. In other cases, the printed mail must be processed concurrently with customer checks so that they can be matched later in the process. In this case, the print jobs are released from the mainframe in a FIFO method and sequenced manually by the floor managers.

Once the jobs are queued for printing, they are released to the print area and printed on high speed printers into a stack or roll format. These printed materials can also be processed in a portrait or landscape print format. Switching high speed printers from one format to another requires significant setup time so it is important for the floor managers to sequence the jobs such that similar print jobs run on the same printer. After printing, material handling personnel must physically move the stacks/rolls to the inserting area of the mail room using carts or roll carriers. In many cases, these carts are a constraint to the flow of work through the system. Due to the fact that printing is a much faster operation, there is usually a staging area for work waiting to be processed by the inserters. While work is in this staging area, jobs are assigned to particular inserting machines based on specific job characteristics (number of pages per job, due date, page orientation, number of enclosures, etc.). This requires manual scheduling by the floor supervisors in order to move the jobs through the mail room in time to meet the required service levels.

The inserting process (or finishing) takes very little time to complete. Many of the machines can operate at rates exceeding 12,000 mail pieces per hour. Although it is a very fast operation, the process is not as simple as it looks. First, the inserting machines take the stacks/rolls and burst the statements to send them through the machine individually. As a statement goes through the machine, advertisements are added based on the characteristics of the customer to whom the statement is being sent. If needed, enclosures are also matched to the statement. An enclosure is any item accompanying a customer statement (an example would be checks included with a bank statement). Complexity is added to this process when these "enclosures" are required because all of the enclosures for a customer must be married up with that customer's

statement. After the statement and inserts are accumulated, the packet is inserted and sealed into an envelope. This process sounds fairly simple but there is a lot of time and effort invested to assure that the correct checks and inserts are matched to the correct statement. Any mistakes can be costly and embarrassing to the finishing vendor. After the jobs have been processed by the inserters, an envelope then goes to either the metering machines which weigh the envelopes to determine the postage rate or to zip-code sorting. Once the job has been weighed, stamped, and zip-code sorted (if required), the envelope is ready for mailing.

As mentioned above, the jobs must be processed in a specific sequence in order to meet required service levels. These service levels are normally described by using a "due date" for each job. Of course, due dates are used in all forms of manufacturing; however, a unique characteristic with the mail processing industry is that the "due date" is actually a due TIME and date. The time is important because a job is considered late if it is does not reach the US Postal Service by a specified time and has to be postmarked with the following day's date. In cases where the print area does not zip-code sort the jobs before processing, the mail must be now be zip-code sorted in order to receive postage discounts. This may require the use of an outside sorting vendor which will require time to process the mail before it can be sent to the postal service for delivery. In order to provide the sorting vendor with the sufficient sorting time, the mail processing company must have the mail ready to be sent hours before the actual mailing deadline of the postal service. This means that in many cases the work must be scheduled precisely, down to the minute, in order for the jobs to flow through the system on time.

These service levels are usually described in terms of a 2 or 3 day standard. It is not 48 hours or 72 hours from the start of production, it must be done in time to meet the mailing deadline of the second or third day. For example, I am running a mail room that must meet a service level which is a 2-day standard. If work arrives on Monday morning at 10:00 A.M. and my mail cut-off time is 4:00 P.M., I have 30 hours to process the job (not 48 hours as 2-day implies) in order for the work to be ready for delivery on the second day. This can lead to dramatic peaks in demand and increased system and manager stress around the "due time".

After describing the general process steps involved in processing mail, several different uses of process simulation for a mail processing company become apparent. Examples of two successful engagements in the mail processing industry are discussed below. They show two very different uses of process simulation in this industry. These companies wanted to analyze different aspects of the process and model different areas of their systems. Process simulation allowed them to have this flexibility.

To address their specific issues, we developed individual, flexible ARENA simulation models. The scenarios to be modeled were defined by the user through Excel spreadsheets. The input workbooks had a predefined set of sheets and categories of information but the user defines the values within these worksheets. Upon starting either of the simulation models, a message box is displayed requesting the file name of the scenario to be run and the file name in which to store the output information. The data in the specified Excel workbook was read in using VBA in ARENA. During the simulation runs, ARENA captures output measures and generates the reports desired by the user.

The objective of each of the projects was to leave the client with a tool that will allow them to simulate various strategies as their system changes into the future.

2 CASE 1

One of our engagements in the mail processing industry involved a company in the process of a merger. In an effort to centralize operations, our client was adding the mail volume from the acquired company to one of their current mail processing centers. This facility appeared to be the logical choice because static spreadsheet calculations indicated that this facility had excess machine capacity and would be able to handle the significant increase in their monthly throughput. Before implementing these system changes, the client decided it would be in their best interest to have a flexible simulation tool to determine the impact, on finishing, of increasing monthly mail volumes. In addition, they wanted to determine if they could meet the service level if it was shortened from a 3-day standard to a 2-day standard. There were several issues that the company wanted the process simulation to address.

The major concern of the manager of finishing was that the arrival of work to the inserters was not consistent throughout the work day. There were peak times during the day, as well as times when the machines were not fully utilized because there was not enough work to process (as in manufacturing). The problem for the manager was how to plan for these peak times of the day so that all of the work could be processed in time to meet the proposed 2-day standard. In order to meet the mailing deadlines, the manager dedicated certain machines to run specific job types. However, as the service deadline approached, the higher priority jobs were split between various machines so that they could meet the service level requirement.

In order to correctly model this situation, we had to give the customer tremendous flexibility in defining the scenarios. This meant allowing the manager a means for creating new jobs and new mail volumes. Since the manager was unsure which machines would be required to process the increased volumes, we had to allow for

flexibility in dedicating machines to a specific job type and defining alternate routings for jobs that were not going to meet the mailing deadlines. In order to handle this flexibility, we created Excel Spreadsheet input files that allowed the manager to assign multiple machine choices for each job type. Thus, as the mailing deadline drew near, secondary machine choices would be available.

The use of the input spreadsheet also allowed the company to add the new jobs and increased volumes to the modeled system in phases rather than all at once. This was very important because, as mentioned above, the purpose of the simulation was to see exactly how the new jobs would effect the system. Therefore, the jobs had to be user-definable so that the company could see exactly how much new volume could be introduced to the system before additional equipment was required to meet the service levels. Adding this flexibility made the simulation model much more realistic and allowed the client to model different strategies for handling the additional mail volumes.

The main question that the simulation model needed to answer was, "What will be the impact of adding new daily volumes to the system and shortening the required service level?" As mentioned above, static spreadsheet calculations showed that there was enough machine time available to handle increased demands. However, the simulation model illustrated the fact that the dynamics of the system would not allow the new mail volumes to be completed in time to meet the desired service level. The reason for this was that the jobs were all arriving during the peak times of the day and that even though there was available machine time in the system, it occurred during the off peak times when there was no new work to process. This simulation showed tremendous backlogs at the inserters and a dramatic increase in the number of jobs that did not meet the mailing deadline. In order to process increased demand in a shorter period of time, new equipment will be required. This was a revelation for the company because without closely analyzing the dynamics of the mail room floor it appeared that there was more than enough machine capacity available to handle increased mail volumes without adding equipment; however, the simulation model proved that this was not actually the case. The simulation model clearly illustrated a point which is sometimes difficult to express through static calculations: extra machine capacity does not always indicate the ability to process more work. In order to truly evaluate the effects of changing the demands on the system (either volume or time demands) you need to conduct more in-depth analysis than static calculations allow. You need to include the dynamics of the process in order to fully understand the implications of proposed system changes.

3 CASE 2

Another print/finish vendor had a very different type of process and, therefore, had different issues which needed to be addressed by a simulation model. This particular company needed a simulation model to address the problems associated with having to process large amounts of mail on a cyclical basis, such as fiscal quarter-end. The most difficult problem the supervisor had to deal with during these peak times of the year was determining which job types to assign to each of the finishing machines. In the past, the supervisor had no means of testing the performance of these machine assignments prior to the arrival of the jobs. The client needed a planning tool designed specifically for this purpose. Through simulation modeling, we gave them this much needed tool.

At the end of every fiscal quarter, this company was required to send statements to each of their clients. This caused the system to be flooded with work. The company had anticipated a 15% increase in volume from the previous year (based on historical increases), in reality the increase was 43% from the prior year. These unexpectedly large increases made the planning function of the supervisor almost impossible because meeting the established service level required the work to be assigned to the proper equipment in order to fully utilize the equipment and avoid time consuming machine set-ups. This meant that some of the mail processing equipment would be dedicated to certain types of jobs for the duration of the quarter end process. The main question this company wanted the simulation model to address was, "How many machines do we need to dedicate to specific job types in order to most efficiently process the work ***and*** how long will the quarter end process take to complete if we assign work in this manner?"

In order to answer this question, we had to create a model which would allow the company to experiment with different machines processing different job types in order to determine which method of job assignment was most effective. This required the flexibility of setting machine preferences for each job type (i.e. first, second, third, and fourth machine choices for each job type) so that if the first choice machine was busy the job would look to the second choice and so on. With all of these parameters available for the supervisor to experiment with, the questions regarding machine assignments were addressed quickly and successfully. The supervisor realized that the initial machine assignments would have resulted in numerous jobs not meeting the service levels. After experimenting with various machine assignments for the quarter end process, the supervisor could decide which jobs needed to be processed by which machines. The supervisor could also accurately forecast the completion times for all of the jobs. The model predicted not only the correct day on

which the work would be complete, but the forecast was within 2% of the actual completion time!

4 SUMMARY

Simulation models are a proven analysis tools in many of today's leading industries. However, there are many industries which have not yet reaped the benefits of analyzing and improving their systems by using flexible simulation models. One of the industries beginning to take advantage of what simulation has to offer is the print/finish industry. Companies which process the enormous amounts of mail which are delivered daily across the country are realizing that the problems they are currently facing are not so different from the problems faced by major manufacturers. In order to solve these problems, they must use the same tools that successful manufacturers have been incorporating into their decision making processes for years. Computer-based process simulation can provide the answers to the capacity planning and job scheduling problems that the print/finish industry is currently confronting.

In one case we looked at the recurring problem of how to deal with increased demand on a system. The simulation revealed where the problems would be and allowed the company to address the problems before they surfaced. In another case, simulation was used to determine the most efficient method of assigning jobs to machines during peak times of the year. The simulation allowed the floor supervisor to test different machine assignment strategies and select the "best" choice to use when the work arrived. What these cases show is that simulation is very capable of helping solve the problems of companies outside the automotive, healthcare, and airline industries.

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AUTHOR BIOGRAPHIES

TIM CURRAN is currently a Simulation Analyst at the Textile/Clothing Technology Corporation ([TC]²). During the past year at [TC]², he has completed consulting projects that addressed capacity and machine assignment issues in the print/finish industry. He has used Visual Basic to increase the ease of use and appearance of the inputs and outputs for flexible simulation models. He helped in the development of a flexible simulation for modeling production environments. He received his B.S. in Industrial Engineering from North Carolina State University.

D. MICHELLE BENJAMIN is currently the Manager of Simulation Services at the Textile/Clothing Technology Corporation ([TC]^2). She has completed consulting projects that address issues in production assembly systems, warehousing and transportation. Michelle's primary focus in production assembly systems is the development of flexible, data-driven simulation models and animation. She received her B.S. in Industrial Engineering and M.S. in Industrial Engineering and Operations Research from Pennsylvania State University.

SUE AUSTIN is currently the Executive Director for the Bell & Howell Integration Services Group. The group combines hardware, software, and people to solve commercial printing and finishing problems. She has an extensive experience in manufacturing inventory, mail integrity, scheduling and tracking, alternative messaging, and consolidated reporting. She has successfully provided consulting services, sold technical services, developed market strategies, and formulated software product strategies. Before joining Bell & Howell, she served as software product manager for another major finishing vendor.