

**THE APPROACH TO DESIGNING A FUTURE PHARMACEUTICAL  
MANUFACTURING FACILITY  
(Using SIMAN and AUTOMOD)**

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**ABSTRACT**

Simulation can be a very powerful tool. Evaluating tank farm batch sizes, determining a good production schedule, or analyzing an AS/RS material handling system are all problems appropriate for simulation and designing a Pharmaceutical Manufacturing facility.

**1 OVERVIEW**

The purpose of this paper is to provide the reader with an alternative approach of how to use simulation for problem solving, decision making and design of a pharmaceutical facility.

We as modelers have a worthwhile contribution to make. In fact, we have an incredible service to provide. We save companies millions of dollars in capital equipment and establishing PL/C logic that will work right the first time. We help shape operational procedures so that a receiving dock supervisor can plan his workforce better. And we shape decision making at the highest levels of management.

Simulation should be used for the following reasons:

- Analyze Proposed Systems Before They are Built
- Analyze Changes to Existing Systems Without Disturbing Them
- Evaluate Complex Systems; resources, control logic, and stochastic elements
- Maintain Better Control Over Experimental Conditions Than would Generally be Possible with The System Itself
- Ability to Study a System with a Long Time Frame in a Short Period of Time
- Quantify and Reduce Risk

Management is concerned about Competition. Management, like most people, make decisions only after reviewing information or data. We are the data suppliers. We supply the important information that is used to direct the companies we work for. Without us good decisions would not be made.

Due to the World Economy and Global Competition, the American manufacturing base has become a focus of attention. In the 90's we are finding that information and data are vital. To become better or more competitive, management has turned to simulation. Again, management's job is easier if we provide data and information so that they can make decisions. As modelers we must become results oriented so that data and information are generated to compare options. You make management's job much easier.

Simulation fits into the big picture. World Class system design requires modelling efforts. We are change agents. The animations we produce become tools for other people. We are thinkers and solvers. To make simulation projects successful we must also become challengers and teachers.

Think of yourselves influencing, persuading, or directing management. You must take a pro-active role. To achieve our role, we must build a methodology that provides quick response.

The "Mini Model" Approach is a methodology for becoming pro-active and providing quick response.

**2 MINI MODELS**

Simulation is not a cure-all. In fact, simulation can be one of the most frustrating experiences of your work life.

Management is looking for quick response and information gathering that helps to focus attention on the truly important issues. How can we reduce overall setup time? Which change gives the best results? What should be implemented first, second,

and third? Do we really need all that equipment, those vehicles, or people?

Management typically enters into a simulation effort when a system has too many variables to quickly evaluate the problem. It goes without saying that a modelling effort typically takes some time. In fact, most modelling efforts of material handling systems last on average 1 to 4 months.

This time span is not conducive to decision making in today's marketplace.

Frustration can mount: management wants answers to complex problems and the modeler must be thorough yet respond quickly.

The basis for the "Mini Model" Approach concerns the gap between management and the modeler. Management can mean a Project Manager, your Boss, as well as Upper Management.

We are taught a formula that looks like this: Problem Formulation, Establish Potential Results, Data Acquisition, Model Building, Experimentation, Analysis of Results, and Documentation. Simulation texts will brainwash you into thinking this process is the only way to be successful at modelling. This is not new news. You have seen this before. It is a terrific methodology except it doesn't take management into consideration.

Where are the results!!! The bottomline is that management must make decisions and they hate to make decisions without data and information. We must be the suppliers of the information so that good decisions are made.

Typical problems with simulation concern the goals and scope. Your project manager or boss is probably one extreme or the other; the type that asks for a model without providing a layout or operating data and procedures, or the type that fills a page with objectives because they think you have to simulate everything and provide answers for every last detail. Both types of managers are dangerous because neither one really have a clue where the problem area or "show stopper" exists in the layout, the control logic, or the operating procedures. Both types of managers are harmful to successful modelling efforts because they expect very detailed models.

It is important to lead the simulation effort by using a solid approach.

Remember your first and second modelling efforts. The first model was probably done during a training class and the second model was probably directed from management to simulate the whole factory. The second model was probably a disaster, while the first model was probably successful.

The approach to use is the "Mini Model" Approach. The point is that writing several small models that are successful is much better than drowning in one very detailed model. Answer specific questions, provide data and information so that management can begin making decisions.

Focus on a specific goal and follow these 3 steps:

1. Start with a pencil and calculator  
review with boss
2. Second step: spreadsheet  
review with boss
3. Third stop: small and simple models  
review with boss

#### MINI MODELS

1. How many AS/RS cranes are required
2. How many blending tanks are needed
3. What is the Packaging Line Throughput
4. When is corridor congestion a problem
5. Will the Receiving Area handle Throughput

#### AS/RS WITH FRONT END CONVEYOR

Pharmaceutical companies desire tight control on inventory. An AS/RS with front end conveyor is an excellent material handling technology to achieve exceptional inventory control and tracking. An example of the Mini Model approach for the AS/RS system would consist of the following steps.

#### THE "MINI MODEL" APPROACH, STEP 1 (Pencil Point Modelling)

Using a constant vertical and horizontal speed, calculate the single and dual cycle time durations. This assumes the length and height of the building are already somewhat defined.

With the approximate cycle time information, calculate the total cycles achievable per hour. To determine the number of cranes, divide the total number of moves required per hour by the total cycles possible.

During this step the equipment utilization and hours worked per day do not need to be included.

If you're taking more than 1-2 days, there wasn't a good starting point defined. Go back to the Project Manager.

Say you calculated 1.5 or 2 cranes. This is the starting point. Go back to your project manager and say, 'did you realize that it will probably be 2 cranes?'

In some cases the 2 cranes will not change. If throughput, control logic, number of bays or tiers, or speeds and accelerations change, then the number of cranes will change. But by walking into the project manager's office the process has begun.

### THE "MINI MODEL" APPROACH, STEP 2 (Worksheet Modelling)

First you must review the Step 1 results with the Project Manager or team. Then proceed, if necessary, to more detail.

A Worksheet/Spreadsheet Analysis is also an excellent tool to evaluate system requirements without writing simulation code. Spreadsheets should be used for "What If" scenario testing.

Again using the AS/RS as an example it important to test various production schedules that would have impact of the material handling system.

A Packaging Line changeover that takes 1 hour instead of 2 hours might increase the pallet throughput by 10 to 15%. To test the production schedule, enter the line rate information per batch. For scenario A include the 1 hour changeover and the 2 hour changeover for scenario B. Then setup the spreadsheet to calculate total pallets required per hour.

Because of the "Rules of Thumb" established during step one, the increased throughput can be compared to crane cycles per hour which will determine if the number of cranes will be affected by the packaging line changeover.

### THE "MINI MODEL" APPROACH, STEP 3 (Mini Simulation Models)

Review the Step 2 results with the Project Manager or Team and if necessary begin Step 3.

By this time several resources have been defined, the layout is taking shape, but the detailed control issues are potentially a concern. Step 3 should be used to establish the control issues, if necessary.

If the AS/RS have several points of delivery and pickup a priority level should be tested and checked against overall response time. In an automated environment a design criteria could be response within 2 minutes. A simulation model becomes an excellent tool for entering the layout information, proposed throughput level, and priority control (always service packaging before receiving) tested. Response time or elapsed time from initial signal to completion of the task can be easily tracked then summarized for the Project Manager or Team.

### ADVANTAGES OF THE "MINI MODEL" APPROACH

1. Minimal support is required.
2. The modeler has the time to continue working on other projects.
3. Frequent communication with the Project Manager helps to establish the modeling goals.
4. Balanced Life becomes possible.

### 3 SIMULATING THE FACILITY

At some point all the Mini Models might need pulled together to simulate the entire facility. The task of simulating the facility is still potentially cumbersome but the number of changes has been greatly reduced.

There is also a chance that the entire facility will not need to be simulated in one model. After Step 3, numerous Mini Models, the modeler and management have established a significant comfort level.

The facility model should only be coded once. Issues that arise concerning batch sizes, changeover times, or double-deep versus single deep storage must be evaluated prior to the final program so that information is quickly turned around to management.

Management will only make decisions AFTER reviewing information. We have a terrific opportunity to direct management decision making if we provide quick response.

### AUTHOR BIOGRAPHIES

Carol A. Park and Ty Getz are Project Engineers with the St. Onge Company, a consulting engineering firm focussing on Material Handling, Information Systems, Distribution and Systems Integration. Both authors are active with IIE and have presented at various seminars including: SIMAN's Users Meeting '92, Pharmaceutical Packaging '92 Conference, and The Pennsylvania State University as a Guest Lecturer.