

COMPELLING REASONS FOR SIMULATING MANUFACTURING OPERATIONS

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In manufacturing and other operations there are situations where the number of variations in a given plan far exceeds the capability of the human mind to comprehend all the possible scenarios. How often has one heard the saying "With the benefit of hindsight . . ."? Would it not be preferable to learn the outcome of decisions without incurring the penalty of live operation? An effective answer is to use computer-based simulation. The financial return from simulation can be very great indeed.

Recently, a Midlands based company achieved considerable success in winning a major contract to supply assembled cabinets to a Japanese manufacturer of domestic ovens. The financial investment and use of limited management resource was considerable. We were asked to examine the logistics of the proposed press shop, and assembly facility.

A personal computer (pc) based simulation model was employed by the consultants to study the movement of materials, from raw material infeed to assembled cabinets leaving the factory. The model provided a colourful and dynamic representation of 'real-life' with object movements traced simultaneously across the display. These objects represented either the processing of components or fork-lift truck movements.

Many of the benefits from using simulation as a management tool are immediate. Take the example just mentioned. At a very early stage of model development it became apparent that:-

- the location of the stores and despatch areas had to be reconsidered
- machine setting times were excessive and a significant reduction was needed
- success in managing the logistics of the new facility was the key to achieving the overall objectives

Simulation, as the word implies, is the modelling of events either current or planned using actual or synthetic data. Any business operation may be considered, some being more complex to model than others. For instance, a process plant may have clearly defined operation criteria, continuous product flow and considerable information on equipment operating characteristics. At the other extreme, a factory working in a jobbing environment may have numerous manufacturing methods, variable batch size, and complex decision criteria applied to shop loading.

Over the past year there has been a steady increase in demand for the simulation of manufacturing operations. One possible explanation for this increased interest can be attributed to the greater publicity surrounding simulation packages, particularly those that are relatively inexpensive and operate on personal computers. However, the often high financial investment involved in implementing advanced manufacturing technologies, combined with the risk of not fully appreciating the total operational characteristics of complex systems, have undoubtedly imparted a keen interest in simulation.

Often the outcome of a simulation model is unexpected and draws attention to potential problematic features of a system which can be more readily corrected at the planning stage. There are many areas in which simulation can predict future events - some worthy of note in relation to manufacturing are as follows:-

- modelling materials flow through discrete production operations, examining machine parameters and the "knock-on" consequences of breakdowns, minimising

inter-operation work-in-progress and resource. This can be useful in training production supervisors to understand the consequences of decisions made in isolation without regard for the impact on the overall operation

- monitoring the movements within a warehouse, either automated using equipment such as automatic guided vehicles and computer-aided pick and place, or purely manual systems
- illustrating the flow of materials in a flexible manufacturing system (FMS), identifying imbalances and restrictions and the effects of equipment malfunction
- modelling the potential outcome of a Just-In-Time (JIT) philosophy and assisting in helping suppliers comprehend the importance of their cooperation
- supporting the financial justification applied to the purchase of additional manufacturing resources. Synthetic data can be used to emulate the operating parameters of new equipment, illustrating the anticipated benefits
- modelling the effect of different decision rules within control systems, so as to determine their effect on efficiencies and flow. For example:- type of shift operation, production schedules and batch priorities
- dynamically modelling the value of inventory employed in supporting a production facility. This is a useful tool in planning the funding for any manufacturing plant and is especially helpful in new project start-ups.

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With some simulation packages it is possible to interface directly with spreadsheet software such as Lotus 1-2-3 and Symphony. Information on machine utilisation may be converted into suitable import files for analysis at a subsequent date. This provides a facility for a realistic analysis of resource utilisation and provides the basis on which to build a financial model. We have successfully utilised simulation as a financial tool and as an aid in justifying expenditure on new plant and equipment.

Furthermore, it is possible to report selected information from a simulation run at user-definable points in simulated time. For example a company may be particularly interested in the level of capital employed in inventory. At regular intervals, therefore, the value of inventory at various stages may be sent to an output file with perhaps messages reflecting the status of the simulation. This information is valuable as a means of supporting the dynamic screen representation of the simulation.

The benefits from investing in a detailed examination of the workings of a manufacturing operation can be appraised against the sometimes damaging effects of installing badly thought-out ideas, and consequently not obtaining the full benefits envisaged. A detailed understanding at the planning stage can prevent:-

- lower than planned output – production targets not being met and sales being lost as a consequence
- a rise in funding as additional resources are needed to correct wrong decisions
- valuable managerial time lost in trouble shooting
- collapse of operations – in some extreme cases simulation has demonstrated that apparently well engineered concepts would not operate at all.

Based on the outcome of modelling operations, we have

seen companies move storage facilities, revise production methods, invest in different plant and equipment, recruit additional operators and make other fundamental changes. The cost of the confidence of knowing the outcome of projects in advance can be as little as £1,000 for the computer software and, for a basic model, four or five days of an experienced programmers time.

Where simulation can help

- work flow design
- factory layout
- production batch parameters
- purchasing policies
- inventory planning
- financial investment analysis
 - plant and equipment
 - inventory
- manning levels
- start-up situations
- supervisor training and education

About the Author

Andrew Taylor obtained an MSc in Industrial Engineering and Production Management from the Cranfield Institute of Technology. He is a Chartered Mechanical and Production Engineer and a member of BPICS. Andrew is also a member of the IProDE Simulation and Logistics Engineering Working Party.

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