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Chapter 1 : PPT ON MODELING AND SIMULATION FOR MANUFACTURING SYSTEM | ENGINEERS O

SIMULATION OF MANUFACTURING SYSTEMS Averill M. Law One of the largest application areas for simulation modeling is that of manufacturing systems, with the first.

Environmental wastes include Energy, water, or raw materials consumed in excess of what is needed to meet customer needs Pollutants and material wastes released into the environment, such as air emissions, wastewater discharges, hazardous wastes and solid wastes trash or discarded scrap Several common and validated methods for evaluating the ergonomics of working postures are employed in the SIMTER tool. Conclusions of Simter tool Determining the influence of levels of automation on ergonomics, and environmental impacts. Fill the gap between Life Cycle Assessment and conventional process simulation, and identifying the most significant environmental factors to be taken into account. With more competition and ever changing consumer demands, manufacturers are frequently realizing the necessity to reengineer their facility to satisfy the needs of many product groups and styles. Manufacturers are constantly under a directive to improve product quality while simultaneously reducing costs and increasing profit margins. Often engineers are assigned one of two major tasks: Either redesign an existing facility to meet current market demands, or design a new plant from scratch. The first task is difficult to perform with the plant already in production, and mistakes in the new alignment can be costly. In this paper, we are going to evaluate the proposed layout of a dining room tabletop plant. The plant consists of a machining cell where all of the legs and side apron pieces are cut and drilled, as well as a sanding operation where all of the tabletops come down a sanding line. After these operations, the tops and legs are joined together and placed on a conveyor system as they pass through the staining room. After the staining operations are performed, the table is sent through a finishing line before moving to final assembly, and then finally to shipping. The models being created not only address issues regarding facility layout, but also can be easily adapted to examine the effect on plant operations resulting from modifications in product styles and machine route changes as is often dictated by market demand. The first step in modeling a furniture facility is to determine the objectives. To generalize, assume that the first objective is to determine staffing levels in a machining cell. The second objective is to determine batch sizes and perform a line-balancing act between multiple machine cells. The third objective is to determine buffer sizes at the major staging areas. After developing the model in ProModel, Sim X increases the usability of the tool by creating a custom front-end user interface utilizing the latest Visual Basic features of Microsoft Excel and the Active X capability of ProModel. The user simply manipulates the input data on a spreadsheet and the input parameters transfer automatically into the simulation model when executed. Model Inputs The model has been developed to be as flexible as possible. The Microsoft Excel front-end interface takes into account specific input parameters by categorizing issues utilizing a series of orksheets in the Excel workbook. Model Outputs Many performance measures are collected in multiple reports. The default statistics being collected by the ProModel Output database include: Buffer levels over time Operator utilization Cycle times for each suit In the example of the tabletop versus apron manufacturing line, one of these detailed system behaviors the model would report is the start and end time for their respective machining cells of dependent pieces that needed to be matched for the staining operation see Figure When dealing with thousands of parts that are elements of hundreds of items, it is often appropriate to examine the start and end times of each part in a more formal format for the entire system. Therefore, Sim X developed a method to integrate the back-end into Microsoft Project to examine the implications of scheduling practices on the production time for a given cutting. RESULTS The models being created not only serve the initial purpose of determining buffer space and resource levels, but they are being used on a regular basis to evaluate new cuttings. This multi-functionality feature has turned the simulation models into operational planning tools. The furniture industry has begun to utilize the latest in simulation technology. With a Microsoft Excel front-end interface, simulation is being brought directly to the plant floor where the everyday engineer can evaluate changes quickly and accurately.

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Chapter 2 : Simulation in manufacturing systems - Wikipedia

sponsor modeling and simulation projects instead of, or in addition to, more commonly used manufacturing system design and improvement methods such as lean manufacturing and six sigma.

Visualization of a direct numerical simulation model. Historically, simulations used in different fields developed largely independently, but 20th century studies of systems theory and cybernetics combined with spreading use of computers across all those fields have led to some unification and a more systematic view of the concept. Physical simulation refers to simulation in which physical objects are substituted for the real thing some circles [4] use the term for computer simulations modelling selected laws of physics , but this article does not. These physical objects are often chosen because they are smaller or cheaper than the actual object or system. Interactive simulation is a special kind of physical simulation, often referred to as a human in the loop simulation, in which physical simulations include human operators, such as in a flight simulator or a driving simulator. Continuous simulation is a simulation where time evolves continuously based on numerical integration of Differential Equations. Hybrid Simulation sometime Combined Simulation corresponds to a mix between Continuous and Discrete Event Simulation and results in integrating numerically the differential equations between two sequential events to reduce number of discontinuities [7] Stand Alone Simulation is a Simulation running on a single workstation by itself. Fidelity is broadly classified as 1 of 3 categories: Specific descriptions of fidelity levels are subject to interpretation but the following generalization can be made: Low â€” the minimum simulation required for a system to respond to accept inputs and provide outputs Medium â€” responds automatically to stimuli, with limited accuracy High â€” nearly indistinguishable or as close as possible to the real system Human in the loop simulations can include a computer simulation as a so-called synthetic environment. This was the best and fastest method to identify the failure cause. Computer simulation A computer simulation or "sim" is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. By changing variables in the simulation, predictions may be made about the behaviour of the system. It is a tool to virtually investigate the behaviour of the system under study. A good example of the usefulness of using computers to simulate can be found in the field of network traffic simulation. In such simulations, the model behaviour will change each simulation according to the set of initial parameters assumed for the environment. Traditionally, the formal modeling of systems has been via a mathematical model , which attempts to find analytical solutions enabling the prediction of the behaviour of the system from a set of parameters and initial conditions. Computer simulation is often used as an adjunct to, or substitution for, modeling systems for which simple closed form analytic solutions are not possible. There are many different types of computer simulation, the common feature they all share is the attempt to generate a sample of representative scenarios for a model in which a complete enumeration of all possible states would be prohibitive or impossible. Several software packages exist for running computer-based simulation modeling e. Monte Carlo simulation, stochastic modeling , multimethod modeling that makes all the modeling almost effortless. Modern usage of the term "computer simulation" may encompass virtually any computer-based representation. Computer science[edit] In computer science , simulation has some specialized meanings: Alan Turing used the term "simulation" to refer to what happens when a universal machine executes a state transition table in modern terminology, a computer runs a program that describes the state transitions, inputs and outputs of a subject discrete-state machine. Accordingly, in theoretical computer science the term simulation is a relation between state transition systems , useful in the study of operational semantics. Less theoretically, an interesting application of computer simulation is to simulate computers using computers. In computer architecture , a type of simulator, typically called an emulator , is often used to execute a program that has to run on some inconvenient type of computer for example, a newly designed computer that has not yet been built or an obsolete computer that is no longer available , or in a tightly controlled testing environment see Computer architecture simulator and Platform virtualization. For example, simulators have been used to debug a microprogram or sometimes commercial application programs, before the program is downloaded to the target machine. Simulators may also be used to interpret fault trees , or test VLSI logic designs before they are constructed. Symbolic simulation uses variables to stand for unknown values. In the field of optimization , simulations of physical processes are often used in conjunction with evolutionary computation to optimize control strategies. Simulation in education and training[edit] Main article: Adaptive educational hypermedia Simulation is extensively used for educational purposes. It is frequently used by way of adaptive hypermedia. Simulation is often used in the training of civilian and military personnel. In such situations they will spend time learning valuable lessons in a "safe" virtual environment yet living a lifelike experience or at least it is the goal. Often the convenience is to permit mistakes during training for a safety-critical system. There is a distinction, though, between simulations used for training and Instructional simulation. Training simulations typically come in one of three categories: Constructive simulation is often referred to as "wargaming" since it bears some resemblance to table-top war games in which players command armies of soldiers and equipment that move around a board. In standardized tests , "live" simulations are sometimes called "high-fidelity", producing "samples of likely performance", as opposed to "low-fidelity", "pencil-and-paper" simulations producing only "signs of possible performance", [18] but the distinction between high, moderate and low fidelity remains relative, depending on the context of a particular comparison. Simulations in education are somewhat like training simulations. They focus on specific tasks. Normally, a user can create some sort of construction within the microworld that will behave in a way consistent with the concepts being modeled. Seymour Papert was one of the first to advocate the value of microworlds, and the Logo programming environment developed by Papert is one of the most famous microworlds. As another example, the Global Challenge Award online STEM learning web site uses microworld simulations to teach science concepts related to global warming and the future of energy. Project Management Simulation is increasingly used to train students and professionals in the art and science of project management. Using simulation for project management training improves learning retention and enhances the learning process. These may, for example, take the form of civics simulations, in which participants assume roles in a simulated society, or international relations simulations in which participants engage in negotiations, alliance formation, trade, diplomacy, and the use of force. Such simulations might be based on fictitious political systems, or be based on current or historical events. This is also called a Social media stresstest. In recent years, there has been increasing use of social simulations for staff training in aid and development agencies. The Carana simulation, for example, was first developed by the United Nations Development Programme , and is now used in a very revised form by the World Bank for training staff to deal with fragile and conflict-affected countries. Specifically, virtual firearms ranges have become the norm in most military training processes and there is a significant amount of data to suggest this is a useful tool for armed professionals. Virtual simulations allow users to interact with a virtual world. Virtual worlds operate on platforms of integrated software and hardware components. In this manner, the system can accept input from the user e. There is a wide variety of input hardware available to accept user input for virtual simulations. The following list briefly describes several of them: For example, if a user physically turns their head, the motion would be captured by the simulation hardware in some way and translated to a corresponding shift in view within the simulation. The systems may have sensors incorporated inside them to sense movements of different body parts e. Alternatively, these systems may have exterior tracking devices or marks that can be detected by external ultrasound, optical receivers or electromagnetic sensors. Internal inertial sensors are also available on some systems. The units may transmit data either wirelessly or through cables. Eye trackers can also be used to detect eye movements so that the system can determine precisely where a user is looking at any given instant. Physical controllers provide input to the simulation only through direct manipulation by the user. In virtual simulations, tactile feedback from physical controllers is highly desirable in a number of simulation environments. High fidelity instrumentation such as instrument panels in virtual aircraft cockpits provides users with actual controls to raise the level of immersion. For example, pilots can use the actual global positioning system controls from the real device in a simulated cockpit to help them practice procedures with the actual device in the context of the integrated cockpit system. This form of interaction may be used either to interact with agents within the simulation e. Voice interaction presumably increases the level of immersion for the user. Users may use headsets with boom microphones, lapel microphones or the room may be equipped with strategically located microphones. Current research into user input systems[edit] Research in future input systems hold a great deal of promise for virtual simulations. Systems such as brainâ€”computer interfaces BCIs offer the ability to further increase the level of immersion for virtual simulation users. Using the BCI, the authors found that subjects were able to freely navigate the virtual environment with relatively minimal effort. It is possible that these types of systems will become standard input modalities in future virtual simulation systems. Virtual simulation output hardware[edit] There is a wide variety of output hardware available to deliver stimulus to users in virtual simulations. Visual displays provide the visual stimulus to the user. Stationary displays can vary from a conventional desktop display to degree wrap around screens to stereo three-dimensional screens. Wrap around screens are typically utilized in what is known as a cave automatic virtual environment CAVE. Stereo three-dimensional screens produce three-dimensional images either with or without special glassesâ€”depending on the design. Head-mounted displays HMDs have small displays that are mounted on headgear worn by the user. These systems are connected directly into the virtual simulation to provide the user with a more immersive experience. Weight, update rates and field of view are some of the key variables that differentiate HMDs. Naturally, heavier HMDs are undesirable as they cause fatigue over time. If the update rate is too slow, the system is unable to update the displays fast enough to correspond with a quick head turn by the user. Slower update rates tend to cause simulation sickness and disrupt the sense of immersion. Field of view or the angular extent of the world that is seen at a given moment field of view can vary from system to system and has been found to affect the users sense of immersion. Several different types of audio systems exist to help the user hear and localize sounds spatially. Special software can be used to produce 3D audio effects 3D audio to create the illusion that sound sources are placed within a defined three-dimensional space around the user. Stationary conventional speaker systems may be used provide dual or multi-channel surround sound. However, external speakers are not as effective as headphones in producing 3D audio effects. They also have the added advantages of masking real world noise and facilitate more effective 3D audio sound effects. These displays provide sense of touch to the user haptic technology. This type of output is sometimes referred to as force feedback. End effector displays can respond to users inputs with resistance and force. These displays provide a sense of motion to the user motion simulator. They often manifest as motion bases for virtual vehicle simulation such as driving simulators or flight simulators. Motion bases are fixed in place but use actuators to move the simulator in ways that can produce the sensations pitching, yawing or rolling.

Chapter 3 : Simulation - Wikipedia

Simulation in manufacturing systems is the use of software to make computer models of manufacturing systems, so to analyze them and thereby obtain important information. It has been syndicated as the second most popular management science among manufacturing managers.

Emphasis in CIM has been on automation, advanced machining capabilities, new organizational structures for facilities and personnel, and information acquisition, storage, transfer, and use. This paper examines CIM from the perspective of the integration of functions associated with management of manufacturing capacity. The premise of the paper is that manufacturing operations should be driven by capacity considerations, not material availability. The manufacturing enterprise must have proven techniques for managing capacity: Total capacity management is a vital foundation to a corporation seeking to achieve a competitive edge and superior productivity. One of the main goals of the CIM architecture is to provide for capacity management. This paper advocates simulation as the primary means for achieving total capacity management. It proposes the use of a common modeling language and common data to support simulation analyses across the many tasks related to TCM. In the physical sciences, models are usually developed based on theoretical laws and principles. Foundations of World-Class Practice. The National Academies Press. The usefulness of models has been demonstrated in describing, designing, and analyzing systems. Model building is a complex process and in most fields involves both inductive and deductive reasoning. The modeling of a system is made easier if 1 physical laws are available to describe the system; 2 a pictorial or graphical representation can be made of the system; and 3 the uncertainty in system inputs, components, and outputs is quantifiable. Because of the complexity of manufacturing systems, a model builder must decide on the elements of the system to include in the model. To make such decisions, a purpose for model building must be established. Typically, a purpose for modeling is related to a stated manufacturing problem or project goal, which helps set the boundaries of the manufacturing system and the level of manufacturing detail necessary to solve the stated problem. The modeling of a manufacturing system is sometimes difficult for one or more of the following reasons: The last decade has seen a tremendous increase in the modeling and simulation of manufacturing systems. This can be attributed to recognition of the need to improve manufacturing operations, and recognition that the impact of decisions need to be assessed before the decisions are implemented. The availability of simulation languages to build and analyze manufacturing models has stimulated this growth. Another contributing factor is the availability of knowledgeable industrial engineers who have a simulation language background Pritsker, a. As Simon points out: When we model systems, we are usually not always interested in their dynamic behavior. Typically, we place our model at some initial point in phase space and watch it mark out a path through the future. Such models are built without having to fit the manufacturing system into a preconceived model structure because the analysis is performed by playing out the logic and relationships included in the model. For this reason, simulation models can be built at either an aggregate or a detailed level. Of fundamental importance is the building of simulation models iteratively, allowing them to be embellished through simple and direct additions. Page Share Cite Suggested Citation: AN OVERVIEW Simulation has been used to support many different manufacturing activities, including product design, process design, facility design, operational scheduling, and schedule management Pritsker, Fundamentally, models developed for simulation analysis relate to the setting of capacity requirements for the manufacturing facility and the determination of how to use the capacity to process orders through the facility. Simulation is further used to manage these activities over time to achieve continuous improvements in manufacturing capabilities. Figure 1 presents a schematic of the manufacturing production-scheduling-operations environment. Capacity management using simulation involves six functions, indicated by the six shaded blocks of Figure 1: Design assessment; Capacity requirements planning and analysis; Scheduling; Schedule management; Schedule execution and dispatching; and Status presentations and statistics. For this paper, no assumption is necessary regarding the need to perform these two functions or whether simulation is used directly or indirectly to accomplish the functions. Design assessment involves the use of a model of manufacturing operations to estimate the performance of the manufacturing system for different levels of demand in conjunction with designed or actual process plans and resource allocations. The process plans are part of the model and specify the job steps, including resource requirements, to make the product. A separate model is sometimes developed to characterize the orders that make up future demand. Before detailed scheduling can be done, a finite capacity analysis determines the level of resources required to meet current demand. When capacity levels are set, detailed scheduling can be accomplished by using the model to simulate allocation of available resources at specified start times to the actual jobs included in the shop orders. Since the model contains the detailed process plans or job steps, the start and completion times of each operation can be established, and hence the order can be scheduled. These schedules can then be distributed for schedule management, which entails the use of current operational status and critical issues to adjust the schedule. Maintaining shop floor discipline when adjustments are made is important. The outputs of schedule management are dispatch lists detailing the scheduled time to perform each job and prescribing the required resources. In addition, methods for improving the scheduling process through the collection of data and the parameterizing of rules to improve the scheduling Page Share Cite Suggested Citation: For example, the application of artificial intelligence tools in conjunction with simulation models can lead to better scheduling practices. The dispatch lists are the basis for schedule execution and dispatching, that is, the actual resource allocations to jobs. Data on operational status are fed back to scheduling and schedule management to determine the frequency with which new schedules need to be prepared. The display of this status information provides a basis for ongoing decision making. Through this feedback link, continuous improvements in manufacturing operations can be made and information gathered for future design assessments and new scheduling algorithms. The feasibility of TCM relies heavily on the ability to build on existing data and models. The use of a common simulation language to obtain a common basis for modeling across the functional problems of TCM makes the evolutionary problem solving described above plausible. Models contain information about manufacturing processes, and by using such models continually, the processes will be better understood. Understanding leads to improved manufacturing and information for improv ing design. Thus, TCM is a mechanism to achieve, using simulation, a new form of Kaizen Imai, by which the processes of manufacturing and decision making can be continually evaluated, changed, and improved. The need for such a mechanism is described in detail in Dynamic Manufacturing Hayes et al. Innovation also is enhanced, because a model developed in one functional area can be used to indicate the possibility of new constructs for another functional area. Thus, improvement cycles in a single functional area may be used to foster new models and concepts in other functional areas. The common model, common data foundation presented for TCM, when fully implemented, provides a basis for achieving world-class manufacturing. TCM functions are performed repetitively to achieve continuous manufacturing improvements. Thus, the sequence in which they are performed or discussed is of minor concern. Design Assessment Simulation has had its most extensive use in the assessment of manufacturing designs where comparisons of different facility organizations group technology cells, transfer lines, job shops, etc. There is no need in this paper to present a catalog of simulation applications for design problems. Because simulation has been used at many levels across a wide spectrum of systems designs, many types of Page Share Cite Suggested Citation: To illustrate this variety of model uses, the primary simulation outputs associated with different levels of model use are given in Table 1. Of course, any simulation output could be employed at any level. Capacity Requirements Planning and Analysis Capacity requirements planning entails evaluating the ability of current resource levels to meet current orders and projected demand. The current shop floor status and inventory levels are considered and process plans are used to calculate the load at work centers. In the planning stage, the load at each work center is evaluated with regard to the actual capacity of the work center. Corrective actions are made as required by rescheduling orders, hiring and layoff reassignments, overtime, outsourcing, alternate routing, tooling changes, and so on.

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Chapter 4 : Simulation Modeling and Analysis

Abstractâ€”This paper proposes a new approach to model and simulate manufacturing systems in order to rapidly respond to the changes of the manufacturing environment, including the.