DOWNLOAD PDF CRITICAL STEPS IN SYSTEMS SIMULATION

Chapter 1 : Steps in a System Reliability, Availability and Maintainability Simulation Analysis

â€¢ the critical steps to be taken in systems simulation (ie, definition of the system and statement of objectives, analysis of data relevant to the model, model construction, validation of the model, sensitivity analysis, and application of the model).

The numerical integration of this problem only involves two lines of code: These equations can also be summarized by a diagram: A flowchart for exponential growth. One may want to consider if, and to what extent, the principle of the two methods, analytical and numerical integration, differ. Let us come back to the differential equation with which we started: In other words, writing: One should thus write: The two approaches therefore are not identical. The formal analytical integration yields the correct result, whereas the numerical integration only provides a numerical estimate. Science of course prefers exact results. Some systems, however, are sufficiently complicated to prevent the derivation of an analytical solution. Should such systems be disregarded for this reason? Numerical integration provides a means to produce approximate solutions. For instance, in the above example, the analytical solution was derived while assuming r constant. This of course very seldom happens, even in highly simplified systems. Numerical integration provides a simple way to address variation over time of parameters such as, in this example, r. Furthermore, sources of variation other than time can be addressed as well. This will be addressed in the next chapter. Numerical integration also provides other, quite important, advantages including: As pointed out in the first section of this chapter, one must bear in mind elements pertaining to 1 the implicit assumptions-simplifications that form the basis of a model structure, 2 the need for expertise when time steps, systems limits, and systems components are chosen, and 3 the necessity to suitably assess simulation model outputs. Such precautions are needed irrespective of the modeling approach chosen. List of symbols for simulation modeling. The first symbol is a rectangle, representing a state variable. In the above example, the state variable is A, or the number of bacteria. Surprisingly enough, the choice of state variables is critical, and also reflects the interests of the modeler. In the virtual coffee-shop system of the former section, several choices could be made. For instance, a specialist in population dynamics or professors concerned by attendance in class would probably choose state variables which express numbers of customers i. Such choices have implications on the very use of the model, of course, but also may lead to pondering the limits of the system to consider what is the limit of information? While such choices are in the hands of the modeler, a rule of thumb exists: This last point brings us to what we feel is a critical remark, although many might perceive it as obvious: This is a very dangerous path to take: Limits must be chosen, and objectives set. The choices of the state variables, of the limits of the system, for instance, are important steps to not drifting towards unmanageable complication. Setting such limits also allows focusing on the applications a model may have. The second symbol is a valve which controls a flow incoming or leaving a state variable; this symbol is always connected to the very flow the valve controls, the third symbol of Table 2. There can be only one valve, that is, one control, per flow. Flows are represented in solid arrows Fig. They represent the increase, or decrease, of contents of the state variable the flow reaches or leaves. Systems nearly always involve flows other than those pertaining only to the increase or decrease in contents of state variables. These flows of information are shown in dashed lines Fig. A flow of information always originates from a coefficient, a possibly variable parameter, a driving function, or from a state variable, as in Fig. Coefficients or parameters are shown as circles, as in Fig. The last symbol introduced by Forrester Table 2. This brings us back to the beginning of this chapter, when dealing with semi-open systems. Driving functions are meant to represent factors that are not included within the set boundaries of the considered system, but nevertheless, influence it from the outside. Examples for driving functions are many: Similarly, in Botanical Epidemiology, the behavior of a pathosystem may strongly depend on temperature or rainfall. Driving functions represent variables that are outside the limits of the considered system, and yet may strongly influence it. They also are likely to vary strongly, and the choice of a suitable time step has to take into account these variations. However, it is important to bear in mind the clear difference between a parameter within a system and a driving function outside its boundaries. Dimensions Dimensions can be represented between brackets. For instance, [L], [T], and [K] stand for length, time, and temperature dimensions, respectively. The speed of an object, for example, would have dimension: T-1], that is, distance per unit of time: Note that the symbol between L and T-1 does not represent a multiplication sign in the algebraic sense. An equation such as: A, the size of the bacterial population has for dimension: T-1]; and RRA, the rate of growth of the bacterial population relative to the bacterial population size has for dimension: T-1] The dimensionality of the equation: Since the number dimensions, 8814 and [N-1], cancel one another in the right hand side of the dimensionality equation, one thus can see that both sides of the equation for RA have the same dimensions. Checking the dimensionalities of an equation is one good way to check if the equation itself is correct. Do note, however, that the reverse is incorrect: Nevertheless, it is a very convenient way to check for gross mistakes. Unlike analytical integration, numerical integration therefore deals with dimensions. In particular, the dimension of the state variables that are involved in a model is one key additional decision a modeler must make. In that sense, numerical integration brings us close to the realm of physical sciences, although of course mathematical correctness is required. Choosing, checking, and pondering the dimensions of each of the elements of a model does not cause additional trouble. On the contrary, it provides a critical instrument to control whether the modeling structure is consistent. This is particularly useful when a model involves a number of state variables, rates, parameters, and driving functions. Note that dimensions are related to units. However, a given dimension may correspond to different units, and the latter should of course be consistent across the structure of a model as well. Note, as indicated above, that all the rate variables are actually speeds of some sort, and thus have dimensions: Dimensions for a set of examples of variables Time constant and integration step Let us return to the notion of time constant. As the model runs, a program is executed. This procedure of numerical integration yields the new values of the state variables. To avoid instability, the time step has to be much smaller than the time constant of the considered system. Most systems, however, involve several processes, and therefore, several rates. One may consider that the time constant of such a system is equal to the reverse of the fastest relative rate of change of one of its state variables. The smaller the time constant of a system, the smaller the time step will have to be. Summary This chapter introduces the concepts of system, model, and simulation. It also introduces the notion of numerical integration, and compares it with analytical integration; thus, the notion of time step, its choice, and the concept of time constant are introduced; by means of a simple exponential process, the syntax of Forrester to represent systems is introduced; and the notion of dimensionality of variables and parameters in a model is explained. Penning de Vries, F. Simulation of Plant Growth and Crop Production. Simulation and Systems Management in Crop Protection. Mathematical Models in Agriculture. Simulation of Ecological Processes. Suggested reading Case, J. Oxford University Press, New York. Modelling Biological Populations in Space and Time. Cambridge University Press, Cambridge. Exercises and questions A reasonable time step to simulate the dynamics of the number of books in a library is a.

Chapter 2 : Integrated circuit design - Wikipedia

Critical STEPS is a modern, unique and innovative courses, which will teach you concepts, methods and skills including critical care procedures with interactive group discussions, hands-on workshops and extensive Simulation sessions.

Find articles by Abdulmohsen H. This article has been cited by other articles in PMC. Abstract One of the most important steps in curriculum development is the introduction of simulation- based medical teaching and learning. Simulation is a generic term that refers to an artificial representation of a real world process to achieve educational goals through experiential learning. Simulation based medical education is defined as any educational activity that utilizes simulation aides to replicate clinical scenarios. Although medical simulation is relatively new, simulation has been used for a long time in other high risk professions such as aviation. Medical simulation allows the acquisition of clinical skills through deliberate practice rather than an apprentice style of learning. Simulation tools serve as an alternative to real patients. A trainee can make mistakes and learn from them without the fear of harming the patient. Simulation- based learning is expensive. However, it is cost-effective if utilized properly. Medical simulation has been found to enhance clinical competence at the undergraduate and postgraduate levels. The objective of this narrative review article is to highlight the importance of simulation as a new teaching method in undergraduate and postgraduate education. Another important finding came from the Harvard Medical Practice Study 1, in which the authors reviewed over 30, randomly selected hospital records at New York State in as part of an interdisciplinary study of medical injury and malpractice litigation. They found that injuries from adverse events occurred in 3. Calls for a change in the instructional methods have resulted in innovative medical curricula. The new curricula stress the importance of proficiency in several clinical skills by medical graduates rather than mere acquisition of knowledge. As evidenced by their endorsement by many of the international bodies and medical schools,[4] it is universally accepted that clinical skills constitute an essential learning outcome. The acquisition of appropriate clinical skills is key to health education; however, students sometimes complete their educational programs armed with theoretical knowledge but lack many of the clinical skills vital for their work. A major challenge for medical undergraduates is the application of theoretical knowledge to the management of patients. Some medical schools in the Middle East have changed their curricula and adopted such educational strategies as problem-based learning. Also many medical schools have started to utilize clinical skills laboratories for training. However, simulation-based learning is not yet well established in this region. The objective of this narrative review article is to highlight the importance of simulation as a new teaching method for undergraduate and postgraduate education. The main search terms were medical simulation, medical simulator, medical education, and clinical skills. These articles were reviewed if they were considered relevant to the search. Clinical skills competencies including communication skills, history-taking, professional attitudes, awareness of ethical basis of healthcare, physical examination, procedural skills, clinical laboratory skills, diagnostic skills, therapeutic skills, resuscitation skills, critical thinking, clinical reasoning, problem solving, team-work, organization skills, management skills, and information technology skills should be part of the core undergraduate curriculum. The pressure of managed care has shaped the forms and frequency of hospitalization and led to a higher percentage of acutely ill patients and shorter inpatient stays. This has resulted in fewer opportunities for the medical learner to access a wide variety of diseases and physical findings. Relying on exposure to real hospital patients during training years may result in an ad-hoc method of learning clinical skills, as this depends on the availability of cases, and consequently to less than optimal development and performance of clinical skills. There are many reports that indicate concerns for the level of skills medical graduates even in western countries possess. Simulators are now widely used in education and training in a variety of high risk professions and disciplines, including the military, commercial airlines, nuclear power plants, business and medicine. There are many examples of curricular reform that include clinical skills training, the use of simulators, and the creation of clinical skills centres. On the other hand, simulation based medical education can be defined as any educational activity that utilizes simulative aides to replicate clinical scenarios. Simulation tools serve as an alternative to the real patient. Trainers can make mistakes and learn from them without the fear of distressing the patient. Experiential learning or learning from experience during simulation based training sometimes involves the use of clinical scenarios as the bases of learning. Debriefing after a scenario is an important component of full-scale simulation. Video recording of the scenario is also used to initiate discussion and to make sure that all learning objectives were covered. Debriefing can focus both around the cognitive process involved in the recognition of the problem and the implementation of the management guidelines and the technical level at which the ability of the learner to apply rules and appropriate responses in a stressful situation is evaluated. Simulation is not intended to replace the need for learning in the clinical environment, so it is important to integrate simulation training with the clinical practice during curriculum development. Simulators can be classified according to their resemblance to reality into low-fidelity, medium- fidelity and high-fidelity simulators. They are usually used to teach novices the basics of technical skills. Example of a low-fidelity simulator is the intravenous insertion arm [Figure 1] and Resusci-Anne [Figure 2]. Moderate fidelity simulators give more resemblance of reality with such features as pulse, heart sounds, and breathing sounds but without the ability to talk and they lack chest or eye movement. They can be used for both the introduction and deeper understanding of specific, increasingly complex competencies. High fidelity simulators combine part or whole body manikins to carry the intervention with computers that drive the manikins to produce physical signs and feed physiological signs to monitors. They are usually designed to resemble the reality. They can talk, breathe, blink, and respond either automatically or manually to physical and pharmacological interventions. In general, the higher the fidelity, the more expensive it is.

Chapter 3 : Simulation-based learning: Just like the real thing

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Failure analysis on any returns Plan for next generation chip using production information if possible Roughly saying, digital IC design can be divided into three parts. This step creates the user functional specification. The user may use a variety of languages and tools to create this description. This step converts the user specification what the user wants the chip to do into a register transfer level RTL description. The RTL describes the exact behavior of the digital circuits on the chip, as well as the interconnections to inputs and outputs. This step takes the RTL, and a library of available logic gates, and creates a chip design. This involves figuring out which gates to use, defining places for them, and wiring them together. Note that the second step, RTL design, is responsible for the chip doing the right thing. The third step, physical design, does not affect the functionality at all if done correctly but determines how fast the chip operates and how much it costs. Design lifecycle[edit] The integrated circuit IC development process starts with defining product requirements, progresses through architectural definition, implementation, bringup and finally productization. The various phases of the integrated circuit development process are described below. Although the phases are presented here in a straightforward fashion, in reality there is iteration and these steps may occur multiple times. Requirements[edit] Before an architecture can be defined some high level product goals must be defined. The requirements are usually generated by a cross functional team that addresses market opportunity , customer needs, feasibility and much more. This phase should result in a product requirements document. Architecture[edit] The architecture defines the fundamental structure, goals and principles of the product. It defines high level concepts and the intrinsic value proposition of the product. Architecture teams take into account many variables and interface with many groups. People creating the architecture generally have a significant amount of experience dealing with systems in the area for which the architecture is being created. The work product of the architecture phase is an architectural specification. Micro-architecture[edit] The micro-architecture is a step closer to the hardware. It implements the architecture and defines specific mechanisms and structures for achieving that implementation. The result of the micro-architecture phase is a micro-architecture specification which describes the methods used to implement the architecture. Implementation[edit] In the implementation phase the design itself is created using the micro-architectural specification as the starting point. This involves low level definition and partitioning, writing code , entering schematics and verification. This phase ends with a design reaching tapeout. Bringup is the process of powering, testing and characterizing the design in the lab. Numerous tests are performed starting from very simple tests such as ensuring that the device will power on to much more complicated tests which try to stress the part in various ways. The result of the bringup phase is documentation of characterization data how well the part performs to spec and errata unexpected behavior. Productization[edit] Productization is the task of taking a design from engineering into mass production manufacturing. Although a design may have successfully met the specifications of the product in the lab during the bringup phase there are many challenges that face product engineers when trying to mass-produce those designs. The IC must be ramped up to production volumes with an acceptable yield. The goal of the productization phase is to reach mass production volumes at an acceptable cost. Sustaining[edit] Once a design is mature and has reached mass production it must be sustained. The process must be continually monitored and problems dealt with quickly to avoid a significant impact on production volumes. The goal of sustaining is to maintain production volumes and continually reduce costs until the product reaches end of life. Design process[edit] Microarchitecture and system-level design[edit] The initial chip design process begins with system-level design and microarchitecture planning. Within IC design companies, management and often analytics will draft a proposal for a design team to start the design of a new chip to fit into an industry segment. Upper-level designers will meet at this stage to decide how the chip will operate functionally. For pure and new designs, the system design stage is where an Instruction set and operation is planned out, and in most chips existing instruction sets are modified for newer functionality. Design at this stage is often statements such as encodes in the MP3 format or implements IEEE floating-point arithmetic. At later stages in the design process, each of these innocent looking statements expands to hundreds of pages of textual documentation. Using digital design components like adders, shifters, and state machines as well as computer architecture concepts like pipelining, superscalar execution, and branch prediction , RTL designers will break a functional description into hardware models of components on the chip working together. Each of the simple statements described in the system design can easily turn into thousands of lines of RTL code, which is why it is extremely difficult to verify that the RTL will do the right thing in all the possible cases that the user may throw at it. To reduce the number of functionality bugs, a separate hardware verification group will take the RTL and design testbenches and systems to check that the RTL actually is performing the same steps under many different conditions, classified as the domain of functional verification. Many techniques are used, none of them perfect but all of them useful â€” extensive logic simulation , formal methods , hardware emulation , lint -like code checking, code coverage , and so on. A tiny error here can make the whole chip useless, or worse. The famous Pentium FDIV bug caused the results of a division to be wrong by at most 61 parts per million, in cases that occurred very infrequently. No one even noticed it until the chip had been in production for months. It has no link to a physical aspect of how the chip would operate in real life at the materials, physics, and electrical engineering side. For this reason, the next step in the IC design process, physical design stage, is to map the RTL into actual geometric representations of all electronics devices, such as capacitors, resistors, logic gates, and transistors that will go on the chip. The main steps of physical design are listed below. In practice there is not a straightforward progression - considerable iteration is required to ensure all objectives are met simultaneously. This is a difficult problem in its own right, called design closure. The RTL is mapped into a gate-level netlist in the target technology of the chip. The gates in the netlist are assigned to nonoverlapping locations on the die area. Iterative logical and placement transformations to close performance and power constraints. Clock signal wiring is commonly, clock trees introduced into the design. The wires that connect the gates in the netlist are added. Performance timing closure , noise signal integrity , and yield Design for manufacturability violations are removed. The design is modified, where possible, to make it as easy and efficient as possible to produce.

Chapter 4 : Simulation Training and Procedural Skills | Australia | Critical Steps

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The Distinction Between Refiners and Originators Definition Lack of systems thinking produces a mental model based mostly on what you can physically see. This tends to give a shallow understanding of the way a system works. For example, when pouring a glass of water we usually think only in terms of turning on the faucet until the glass is full, and then turning it off. The term systems thinking is preferred to holistic or whole systems, which have looser and more intuitive meanings, and emphasize understanding the whole rather than the dynamic structure of the system. Systems thinking is not stepping back to look at the whole, the big picture, or a higher level. Nor is it realizing that when a butterfly flaps its wings in one place, that could cause a hurricane far away. This helps, but does not lead to the major insights that emerge when the feedback loop structure of the system becomes visible. When this happens night becomes day. Systems thinking is the first step to an even higher level: Systems thinking [is] a way of thinking about, and a language for describing and understanding, the forces and interrelationships that shape the behavior of systems. This discipline helps us to see how to change systems more effectively, and to act more in tune with the natural processes of the natural and economic world. Event Oriented Thinkers and System Thinkers Once you graduate to true systems thinking, you see system behavior as the result of its feedback loops. Feedback loops are everywhere. In the example the simple act of pouring a glass of water can be understood at a much deeper level by drawing a simple diagram representing the major feedback loop involved. Starting at the top, the faucet position affects the water flow, which affects the current water level. The desired water level minus the current water level equals the perceived gap. As the water level rises, the gap closes, which affects the faucet position, which affects the water flow, which causes the water level to gracefully rise to the desired water level, and not overshoot. While this simple example does not lead to any powerful insights, the application of systems thinking to more complex problems can often turn a problem from impossible to solve into one so easy to solve that you may forget that moments ago, or years ago, it was impossible. He pointed at people around the room, easily dividing them into those two groups on the basis of who was dull and who was interesting. Then he confirmed his decisions by observing how frequently they referred to TV shows and characters as they chatted, as well as asking some how much television they watched. It was a marvelous display of a theory proved right. Everyone in the world can also be divided into two groups based on how they see the world around them: They see the world as a rag tag collection of parts and events. Each event has a cause and if you want to solve a problem, find the cause and fix that. The solution, then, is to get them to stop behaving so irresponsibly. This can be done with laws stating what to do and not to do, plus emotional appeals to be nice to the environment. When that solution fails, as it has for over 40 years, they just throw up their hands and call it a hard problem. This mindset is also known as Classic Activism. Systems thinkers see the problem entirely differently. They see immense positive feedback loops causing swarms of agents to exploit the Earth for their own benefit and population growth. This mode becomes unsustainable when negative feedback loops finally start to push back as environmental limits are approached. Instead, they see the structure of the system as causing that misbehavior. To solve the problem, system structure must be understood and changed, so that feedback loops can be redesigned to cause people to behave sustainably as a natural part of their everyday existence. This takes far more work than writing a few quick new laws and pleading to save the world. The Key Concepts of Systems Thinking Systems thinking revolves around a handful of concepts that anyone who is determined to learn can master, with study and practice. The key concepts are: All systems are composed of inter-connected parts. The connections cause behavior of one part to affect another. All parts are connected. A change to any part or connection affects the entire system. The structure of a system determines its behavior. Structure is the pattern of part connections, which is how the system is organized. System behavior is an emergent phenomenon. How a system behaves cannot be determined by inspection of its parts and structure. This is because parts are tightly coupled, the parts and structure are constantly changing, feedback loops are present, nonlinear relationships exist, behavior paths are history dependent, the system is self-organizing and adaptive, emergent behavior is counterintuitive, time delays exist, the human mind has very limited calculation abilities, etc. Once you realize how complex the behavior dynamics of even a simple system really is, you will never again assume you can look at a system and predict how it will behave. A feedback loop is a series of connections causing output from one part to eventually influence input to that same part. This circular flow results in large amplification, delay, and dampening effects, which is what causes the gross behavior of the system. Every part is involved in one or more feedback loops. Systems have more feedback loops than parts, which causes unimaginable complexity. Complex social systems exhibit counter intuitive behavior. The problems of such systems therefore cannot be solved using intuition and our everyday problem solving methods. The use of intuitive methods to solve difficult complex social system problems is a common trap, so common the entire environmental movement has fallen into it. Only analytical methods using tools that fit the problem will solve difficult complex social system problems. The first such tool to adopt is true systems thinking. The second one is a process that fits the problem. The third one, unless it is an easy problem, is system dynamics. Unawareness - Completely unaware of the concept of systems thinking. Shallow Awareness - The person is reasonably aware of the concept but does not understand it to any serious depth. He or she throws around the right buzzwords, and may have some good systems thinking intuition, but with few effective results. The problem here is this type of person may strongly feel they are a systems thinker. But they are not, so they do not gain any of the benefits of true systems thinking analysis. They also cannot tell a good systems analysis from a bad one. This type of person can be called a pseudo systems thinker. Unfortunately most seem to be on level 1. Deep Awareness - This type of person is fully aware of the key concepts of systems thinking and has a sound grasp of the importance and potential of systems thinking. They think more like a user of systems thinking output or a manager of work efforts that involve systems thinking. They understand what systems thinking is on the surface, but how to build glass box models remains a mystery. They can read causal flow diagrams and simulation models to at least a small degree, and can think a little in terms of feedback loops, but they cannot create good diagrams and models. They know what system structure and reinforcing and balancing feedback loops are, and why the forces those loops create are the most powerful forces in the humans system. Novice - A novice has deep awareness and has begun to penetrate the black box of why a system behaves the way it does. At a minimum, they have learned how to create original causal flow diagrams and can use them to solve many easy and some medium difficulty complex social system problems. A really good novice will be able to read simulation models fluently. Expert - An expert has gone a giant step further than a novice. They have learned how to create original correct simulation models using the tool of system dynamics. This allows them to solve difficult complex social system problems. Any organization working on solving the sustainability problem using an original approach needs at least one expert on their staff or needs to somehow have their work driven by one. They also need many novices. Guru - This is an expert who is able to teach others to become experts and who can make crucial original contributions to solving extremely difficult complex social system problems. If you would like to become a deep awareness or novice systems thinker, start with the book The Fifth Discipline: Work through to the fifth chapter, titled A Shift of Mind. There Peter does indeed shift the mind with a superlative introduction to systems thinking, one so good the book turned much of the American business world onto systems thinking in the s, when it was first published. Systems Thinking and Modeling for a Complex World. As the title suggests, this will not only turn you into a systems thinker. It will also turn you into a modeler, using system dynamics. This is the book I taught myself modeling with, and The Fifth Discipline is the book that planted the seeds that lead to taking that plunge. The Distinction Between Refiners and Originators There must be a distinction between refiners and originators. A refiner can only improve upon a model that someone else has created. A good example of refiners is the Limits to Growth team of the early Their main work output was World3, a simulation model of the world and how it was close to overshooting its limits. The stocks, subsystems, and general behavior and insights were all about the same in both models. The main difference was World3 was more complete and its parameters and equations were based on elaborate research, allowing its scenarios to be more reliable and cover greater depth than World2. But a refiner can only improve. They cannot create new models containing major new insights. This requires an originator, such as Forrester. Notice how that without at least one originator being involved, the Limits to Growth phenomenon would have never occurred. But there is a much deeper insight here. Because the Limits to Growth team contained no originators, they failed to see that they were modeling only the superficial layer of the environmental proper coupling subproblem. If using root cause analysis and true systems thinking they had gone further and included the fundamental layer and at least the change resistance subproblem , then the course of environmental history might be much different.

Chapter 5 : Systems Thinking - Tool/Concept/Definition

Overview[edit] System dynamics is a methodology and mathematical modeling technique to frame, understand, and discuss complex issues and problems. Originally developed in the s to help corporate managers improve their understanding of industrial processes, SD is currently being used throughout the public and private sector for policy analysis and design. SD models solve the problem of simultaneity mutual causation by updating all variables in small time increments with positive and negative feedbacks and time delays structuring the interactions and control. This model forecast that exponential growth of population and capital, with finite resource sources and sinks and perception delays, would lead to economic collapse during the 21st century under a wide variety of growth scenarios. System dynamics is an aspect of systems theory as a method to understand the dynamic behavior of complex systems. The basis of the method is the recognition that the structure of any system, the many circular, interlocking, sometimes time-delayed relationships among its components, is often just as important in determining its behavior as the individual components themselves. Examples are chaos theory and social dynamics. It is also claimed that because there are often properties-of-the-whole which cannot be found among the properties-of-the-elements, in some cases the behavior of the whole cannot be explained in terms of the behavior of the parts. History[edit] System dynamics was created during the mids [7] by Professor Jay Forrester of the Massachusetts Institute of Technology. His initial goal was to determine how his background in science and engineering could be brought to bear, in some useful way, on the core issues that determine the success or failure of corporations. At that time, the managers at GE were perplexed because employment at their appliance plants in Kentucky exhibited a significant three-year cycle. The business cycle was judged to be an insufficient explanation for the employment instability. From hand simulations or calculations of the stock-flow-feedback structure of the GE plants, which included the existing corporate decision-making structure for hiring and layoffs, Forrester was able to show how the instability in GE employment was due to the internal structure of the firm and not to an external force such as the business cycle. These hand simulations were the start of the field of system dynamics. Forrester published the first, and still classic, book in the field titled Industrial Dynamics in In , however, an unexpected occurrence caused the field to broaden beyond corporate modeling. The result of the Collins-Forrester collaboration was a book titled Urban Dynamics. The Urban Dynamics model presented in the book was the first major non-corporate application of system dynamics. At the Bern meeting, Forrester was asked if system dynamics could be used to address the predicament of mankind. His answer, of course, was that it could. As an illustration of the use of system dynamics, imagine an organisation that plans to introduce an innovative new durable consumer product. The organisation needs to understand the possible market dynamics in order to design marketing and production plans. Causal loop diagrams[edit] Main article: Causal loop diagram In the system dynamics methodology, a problem or a system e. By capturing interactions and consequently the feedback loops see figure below , a causal loop diagram reveals the structure of a system. Causal loop diagram of New product adoption model There are two feedback loops in this diagram. The positive reinforcement labeled R loop on the right indicates that the more people have already adopted the new product, the stronger the word-of-mouth impact. There will be more references to the product, more demonstrations, and more reviews. This positive feedback should generate sales that continue to grow. The second feedback loop on the left is negative reinforcement or "balancing" and hence labeled B. Clearly, growth cannot continue forever, because as more and more people adopt, there remain fewer and fewer potential adopters. Both feedback loops act simultaneously, but at different times they may have different strengths. Thus one might expect growing sales in the initial years, and then declining sales in the later years. However, in general a causal loop diagram does not specify the structure of a system sufficiently to permit determination of its behavior from the visual representation alone. To perform a more detailed quantitative analysis, a causal loop diagram is transformed to a stock and flow diagram. A stock and flow model helps in studying and analyzing the system in a quantitative way; such models are usually built and simulated using computer software. A stock is the term for any entity that accumulates or depletes over time. A flow is the rate of change in a stock. A flow is the rate of accumulation of the stock In our example, there are two stocks: Potential adopters and Adopters. There is one flow: For every new adopter, the stock of potential adopters declines by one, and the stock of adopters increases by one. Stock and flow diagram of New product adoption model Equations[edit] The real power of system dynamics is utilised through simulation. Although it is possible to perform the modeling in a spreadsheet , there are a variety of software packages that have been optimised for this. The steps involved in a simulation are: Define the problem boundary Identify the most important stocks and flows that change these stock levels Identify sources of information that impact the flows Identify the main feedback loops Draw a causal loop diagram that links the stocks, flows and sources of information Write the equations that determine the flows Estimate the parameters and initial conditions. These can be estimated using statistical methods, expert opinion, market research data or other relevant sources of information. In this example, the equations that change the two stocks via the flow are:

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Chapter 6 : Simulation-based medical teaching and learning

A simulation of a system is the operation of a model of the system; "Simulation Model". The steps involved in developing a simulation model, designing a simulation experiment, and performing simulation analysis are: [1] Step 1.

This article has been cited by other articles in PMC. Abstract Simulation is a technique for practice and learning that can be applied to many different disciplines and trainees. Simulation-based medical education can be a platform which provides a valuable tool in learning to mitigate ethical tensions and resolve practical dilemmas. Simulation-based training techniques, tools, and strategies can be applied in designing structured learning experiences, as well as be used as a measurement tool linked to targeted teamwork competencies and learning objectives. It has been widely applied in fields such aviation and the military. In medicine, simulation offers good scope for training of interdisciplinary medical teams. The realistic scenarios and equipment allows for retraining and practice till one can master the procedure or skill. An increasing number of health care institutions and medical schools are now turning to simulation-based learning. Teamwork training conducted in the simulated environment may offer an additive benefit to the traditional didactic instruction, enhance performance, and possibly also help reduce errors. These two competing needs can sometimes pose a dilemma in medical education. Also, medicine is a discipline that is a science as well as an art and repeated exposures with enhanced experience will help improve skills and confidence. Doctors have to be good team players and their training programmes must systematically inculcate these skills. In the s, during the time when personal computers became less expensive and more simulation software became available, independent groups began to develop simulator systems. Much of this was utilized in the areas of aviation, military training, nuclear power generation, and space flights. In the early s, more comprehensive anesthesia simulation environments were produced, which included the MedSim and, later, the Medical Education Technologies Inc. Aviation simulation training concepts then begun to be gradually introduced into anesthesia and other areas of medicine like critical care, obstetrics, emergency medicine, and internal medicine. Current full-body simulator models incorporate computerized models that closely approximate the physiology seen in the human body. Simulation-based medical education can be a platform for learning to mitigate ethical tensions and resolve practical dilemmas. Simulationbased training techniques, tools, and strategies can be applied in designing structured learning experiences, as well as be used as a measurement tool linked to targeted teamwork competencies and learning objectives. Simulation-based learning itself is not new. It has been applied widely in the aviation industry also known as CRM or crew resource management , anesthesiology, as well as in the military. It helps to mitigate errors and maintain a culture of safety, especially in these industries where there is zero tolerance for any deviation from set standards. Medical, nursing, and other health care staff also have the opportunity to develop and refine their skills, repeatedly if necessary, using simulation technology without putting patients at risk. In both aviation and health care domains, human performance is strongly influenced by the situational context, i. In aviation, more than 50 years of research has shown that superior cognitive and technical skills are not enough to ensure safety: Similar observations are also now being made in the practice of medicine. It has indeed turned out to be a very flexible and durable form of medical education and training. Much of the cost is contributed to by the manpower or technician costs as well as cost of the laboratory setup and maintenance. The computer- and information technologycontrolled equipment advances medical learning and ensures that students and doctors learn procedures and treatment protocols before performing them on actual patients. The simulated environment allows learning and re-learning as often as required to correct mistakes, allowing the trainee to perfect steps and fine-tune skills to optimize clinical outcomes. The simulated situation and scenarios can give students and inexperienced junior doctors realistic exposure to such cases. It can certainly help in making books and lecture materials come alive. It helps ensure that students and trainees gain clinical experience without having to depend on chance encounters of certain cases. Many also believe that simulation-based learning enhances efficiency of the learning process in a controlled and safe environment. These are also being utilized to assess candidates in the objective structured clinical examination OSCE. Technical and functional expertise training Problem-solving and decision-making skills Interpersonal and communications skills or team-based competencies All of these share a common thread in that they require active listening and collaboration besides possession of the basic knowledge and skills. With every training programme it is best to have feedback and debriefing sessions that follow. Feedback must be linked to learning outcomes and there must be effective debriefing protocols following all simulation exercises. Studies have shown that simulation improves learning. Multidisciplinary teams deliver a multitude of health care services today but many organizations still remain focused on individual technical responsibilities, leaving practitioners inadequately prepared to enter complex team-based settings. When health care providers of different disciplines train separately, it may be difficult to integrate their capabilities. Effective multidisciplinary teams must always have good communications and leadershipsharing behavior, which can help ensure patient safety. Inculcation of teamwork values is an example of the nontechnical, but essential, part of training of medical professionals. Simulation has the potential to create lasting and sustainable behavior and culture change that will make health care more effective and safer. Transformational change can only come about when the learner recognizes the problems and then adopts a proactive approach to work on it and correct it. The essence of a team is the shared goal and commitment. It represents a powerful unit of collective performance, which can be done as an individual or mutually. These must eventually translate common purpose into specific performance goals. One of the important ingredients of teams with good outcomes is the basic discipline of the team. Simulation training and practice affords the essentials for creating an effective medical team with a sense of group identity, group efficacy, and trust amongst members. There needs to be true engagement and understanding for team members to work together well. Examples of these can be seen in the incredible teamwork and excellent team dynamics that can exist during good resuscitation, certain surgery, and the more complex intensive care cases. Members who have had sufficient training and knowledge can be flexible enough to adapt to any new situation and break out of their ingrained routines and they get more proficient with time. A learning team will have some degree of substitution, defined roles and responsibilities, flexibility, good process flow, and an awareness of common goals. Conflict resolution is another aspect of teamwork that can be practiced during simulations. Medical staff reported that error is an important issue but difficult to discuss and that it was not being handled well in their hospital. The composition varies according to the objective of the teams; examples include stroke management teams, trauma teams, acute coronary syndrome intervention teams, etc. The training of each member of the team is decided by his or her own discipline. As such, there is a need to bring them together in an integrated fashion to learn how to manage a patient with complex medical problems. No one discipline is more important than the other. Everyone has a role to play. There must also be some flexibility allowed at various junctures of decision-making and intervention. Team-work skills and interpersonal communication techniques are essential components of such training and exercise. They must be able to objectively view the group dynamics and interaction within the teams they train and provide valuable feedback. Videotaping the role-playing is useful as it can be played back and the highlights shared with the team as part of their learning process. Trainers can points out both the negative and positive practices and behaviors to the participants. These writers can customize the scenarios for interdisciplinary team training and role-playing in order to highlight or facilitate certain roles or team interaction. These scenarios should be realistic, practical, and comprehensive. Scenarios would usually also have event triggers, environmental distractors, and supporting events. They should be developed systematically with proficiency-based assessment in place, which can emphasize integrative team performance as well as technical performance. All practice and action should also be validated by data and evidence. The absence of clearly defined specified roles may persist, despite generally acceptable team performance; this may not become obvious until there is a change in team members, which then reveals the role confusion. Most health care systems have no or few processes or backup plans when errors occur. However, there is no method to measure this. It can be used for undergraduate training such as in the study of anatomy, physiological functions, familiarization with medical examination techniques , for residency training e. It must include adequate space for training small groups, rooms with one-way mirrors, and sufficient space for equipment setup, amongst other facilities. There must also be provision for video recording equipment. Manpower would include full-time technicians and a manager; the trainers are usually part-time medical personnel. The decision to purchase suitable mannequins and equipment must only be made after adequate demonstration and trials have been done and all parties are satisfied. It is also important to have technical support from the vendors in the long term. The different forms of medical simulation technology training that can be considered for the center would include: The centerpiece is usually a fullsized patient simulator that blinks, breathes, and has heart beat, pulse, and respiratory sounds. This mannequin can be very technologically advanced. This simulator can be used for scenarios from simple physical examination to interdisciplinary major trauma management. Some simulators can even recognize injected medications via a laser bar-code reader and then respond with appropriate vital sign changes Simulated clinical environment: An intensive care unit, emergency room cubicle, or operating room is prepared with all the equipment and the crash cart. The setup is as realistic as the actual facility. Trainees can familiarize themselves with the setup and arrangements. Various stations can be set up, depending on what the focus is. These stations will have all the relevant equipment and setup for the procedure to be carried out, e. As more health care institutions adopt electronic medical records to track and to manage patients, this can also be a station setup in the center. The system utilized will have fictitious patients with their histories, notes, and lab results. There may also be system integration, such as the link between records and the laboratory as well as the radiology results digitalized radiographs. Currently, adult simulation equipment and mannequins are already well established. Pediatric ones are still in the experimental stage, but there will be future developments. For institutions that cannot afford to set up an entire simulation laboratory, a less expensive option could be to invest in simulation mannequins only. This could be purchased in different numbers and be used for training purposes. Institutions and their leaders must learn to accept the candidates with an open mind. The leaders must be strict with their education and training portions.

Chapter 7 : System dynamics - Wikipedia

As pointed out in the first section of this chapter, one must bear in mind elements pertaining to (1) the implicit assumptions-simplifications that form the basis of a model structure, (2) the need for expertise when time steps, systems limits, and systems components are chosen, and (3) the necessity to suitably assess simulation model outputs.

What Is Central Limit Theorem? For practical purposes, the main idea of the central limit theorem CLT is that the average of a sample of observations drawn from some population with any shape-distribution is approximately distributed as a normal distribution if certain conditions are met. In theoretical statistics there are several versions of the central limit theorem depending on how these conditions are specified. These are concerned with the types of assumptions made about the distribution of the parent population population from which the sample is drawn and the actual sampling procedure. One of the simplest versions of the theorem says that if is a random sample of size n say, n larger than 30 from an infinite population, finite standard deviation , then the standardized sample mean converges to a standard normal distribution or, equivalently, the sample mean approaches a normal distribution with mean equal to the population mean and standard deviation equal to standard deviation of the population divided by the square root of sample size n. In applications of the central limit theorem to practical problems in statistical inference, however, statisticians are more interested in how closely the approximate distribution of the sample mean follows a normal distribution for finite sample sizes, than the limiting distribution itself. Sufficiently close agreement with a normal distribution allows statisticians to use normal theory for making inferences about population parameters such as the mean using the sample mean, irrespective of the actual form of the parent population. It is well known that whatever the parent population is, the standardized variable will have a distribution with a mean 0 and standard deviation 1 under random sampling. Moreover, if the parent population is normal, then it is distributed exactly as a standard normal variable for any positive integer n. It is generally not possible to state conditions under which the approximation given by the central limit theorem works and what sample sizes are needed before the approximation becomes good enough. As a general guideline, statisticians have used the prescription that if the parent distribution is symmetric and relatively short-tailed, then the sample mean reaches approximate normality for smaller samples than if the parent population is skewed or long-tailed. In this lesson, we will study the behavior of the mean of samples of different sizes drawn from a variety of parent populations. Examining sampling distributions of sample means computed from samples of different sizes drawn from a variety of distributions, allow us to gain some insight into the behavior of the sample mean under those specific conditions as well as examine the validity of the guidelines mentioned above for using the central limit theorem in practice. Under certain conditions, in large samples, the sampling distribution of the sample mean can be approximated by a normal distribution. The sample size needed for the approximation to be adequate depends strongly on the shape of the parent distribution. Symmetry or lack thereof is particularly important. For a symmetric parent distribution, even if very different from the shape of a normal distribution, an adequate approximation can be obtained with small samples e. For symmetric short-tailed parent distributions, the sample mean reaches approximate normality for smaller samples than if the parent population is skewed and long-tailed. In some extreme cases e. For some distributions without first and second moments e. Many problems in analyzing data involve describing how variables are related. The simplest of all models describing the relationship between two variables is a linear, or straight-line, model. A more elegant, and conventional method is that of "least squares", which finds the line minimizing the sum of distances between observed points and the fitted line. Know that there is a simple connection between the numerical coefficients in the regression equation and the slope and intercept of regression line. Know that a single summary statistic like a correlation coefficient does not tell the whole story. A scatter plot is an essential complement to examining the relationship between the two variables. Analysis of Variance The tests we have learned up to this point allow us to test hypotheses that examine the difference between only two means. ANOVA does this by examining the ratio of variability between two conditions and variability within each condition. For example, say we give a drug that we believe will improve memory to a group of people and give a placebo to another group of people. We might measure memory performance by the number of words recalled from a list we ask everyone to memorize. A t-test would compare the likelihood of observing the difference in the mean number of words recalled for each group. An ANOVA test, on the other hand, would compare the variability that we observe between the two conditions to the variability observed within each condition. Recall that we measure variability as the sum of the difference of each score from the mean. Exponential Density Function An important class of decision problems under uncertainty concerns the chance between events. For example, the chance of the length of time to next breakdown of a machine not exceeding a certain time, such as the copying machine in your office not to break during this week. Exponential distribution gives distribution of time between independent events occurring at a constant rate. Its density function is: Applications include probabilistic assessment of the time between arrival of patients to the emergency room of a hospital, and arrival of ships to a particular port.

Chapter 8 : Cool Smartphones | Simulation | ANSYS Advantage

Many critical questions are pitfalls in modeling and simulation? The intended Step 3. Collect and process real system data. Step 4. Formulate and develop a model.

Unfortunately, the model omits elements and fails to capture the process accurately, which makes understanding the challenges and responsibilities of intelligence analysis much more difficult. It also complicates the tasks of recognizing where errors can occur and determining methods for change based on accurate predictions of behavior. Our analysis of the Intelligence Cycle, employing a systems approach and a simulation created to represent it, demonstrated these shortcomings. The Traditional Intelligence Cycle The Intelligence Cycle is customarily illustrated as a repeating process consisting of five steps. Collection refers to the gathering of raw data to meet the collection requirements. These data can be derived from any number and type of open and secret sources. Processing refers to the conversion of raw data into a format analysts can use. Analysis and production describes the process of evaluating data for reliability, validity, and relevance; integrating and analyzing it; and converting the product of this effort into a meaningful whole, which includes assessments of events and implications of the information collected. Finally, the product is disseminated to its intended audience. It is prescriptive, structured, made up of discrete steps, and expected to yield a specific product. The traditional depiction of the process in the Intelligence Cycle, however, is not an accurate representation of the way intelligence is produced. The notion of a cycle assumes that the steps will proceed in the prescribed order and that the process will repeat itself continuously with reliable results. This type of representation gives the impression that all inputs are constant and flow automatically, but it does not address elements that may influence the movement of the cycle, positively or negatively. The most significant assumption about the Intelligence Cycle model, that it provides a means for helping managers and analysts deliver a reliable product, should be examined at the outset. This can be accomplished through two types of analyses. The first is a systematic examination of the elements of the process, the inputs it relies on, and the outcomes that can be expected. The second uses a systemic approach to identifying the relationships of the elements in the process and their influence on each other. Systematic Analysis Many disciplines for example, business process, organizational management, human performance technology, program evaluation, systems engineering, and instructional systems design employ specific methods to analyze the effectiveness of products, programs, or policy implementation. Although they are often given different, domain-specific names and may involve varying levels of detail, these analytic methods involve the identification of inputs, processes, and outputs. Once these elements are identified, the evaluation process maps the relationships of the inputs, their implementation in processes, and their impact on intendedâ€”as opposed to actualâ€"outputs. Along the way, existing practices and barriers to reaching goals effectively can be identified. Finally, interventions, which can range in complexity from simple job aids to a complete restructuring of the process, can be proposed and implemented and their impacts assessed. Findings Based on Systematic Analysis The Intelligence Cycle is represented visually to provide an easy-to-grasp and easy-to-remember representation of a complex process. Although this type of representation may make the flow of information and the interrelationships of steps easy to identify, it does not indicate who or what may affect the completion of a step or the resources needed to begin the next step. In its concise form, then, the visual representation of the Intelligence Cycle is reduced to a map of information handling. Without explicit descriptions of the steps in the process or the benefit of prior knowledge, it can raise questions of accuracy and completeness and can occasion misconceptions, particularly concerning the roles and responsibilities of intelligence analysts. Inputs Table [PDF It is difficult to see from this analysis specifically who is responsible for providing inputs, carrying out the processes, and producing outputs; and what requirements are expected of the inputs and outputs. An important issue that this analysis only partly clarifies is the role of analysts. Nor does it demonstrate how great a burden the process places on them, an especially important point. Another important defect in this analysis is that steps in the cycle do not accurately represent the differences in the cognitive complexity involved in preparing a long-range assessment or a national intelligence estimate and that required for a two-paragraph brief on a current situation. The same can be said about the process required to develop each of the products. The Intelligence Cycle depicts a sequential process and does not provide for iterations between steps. This is not an accurate reflection of what happens, particularly in the collection and production steps, where the challenges of defining policymaker needs and shaping collection necessitate repeated refinement of requirements by policymakers or of inferences by the Intelligence Community. Both models provide a more realistic view of the entire process. However, neither model provides an effective way of showing who is responsible for what, and neither reflects the impact of the work on the individuals responsible for producing the reportsâ€"particularly the analystâ€"nor the reliance of the analyst on a variety of factors beyond his or her control. In sum, this brief evaluation of the Intelligence Cycle with respect to its inputs, processes, and outputs shows us that the traditional model: To better understand these limitations and the relationships among elements in the process, it is necessary to step back and take a longer view of the process, using a different method of analysis. Systemic Analysis If we think of the phenomenon that is being described by the Intelligence Cycle as a system and perform a systems analysis, we may be able to derive a greater understanding of process relationships, a better representation of the variables affecting the process, and a greater level of detail regarding the process itself. The premise that underlies systems analysis as a basis for understanding phenomena is that the whole is greater than the sum of its parts. A systems analysis allows for the inclusion of a variety of influences and for the identification of outliers that are obfuscated in other types of analyses but that often play major roles. A systems analysis is accomplished through the examination of phenomena as cause-and-effect patterns of behavior. It requires a close examination of relationships and their influences, provides a longer view of these relationships, and often reveals new insights based on trends rather than on discrete events. The elements of the Intelligence Cycle are identified in terms of their relationships with each other, the flow of the process, and phenomena that influence the elements and the flow. The model uses four icons to represent actions and relationships within the system: The icons and their placement within the systems model show the relationships of the elements of the analyzed phenomenon. It also provides a way to understand the impact of change in any area of the Intelligence Cycle on other elements, either through reflection or by applying mathematical values to the influences and relationships and running simulations of the model. As in the traditional Intelligence Cycle model, the systems model begins with requirements for information that generally come from policymakers. These requirements are represented by a stock found in the upper left-hand quarter of the diagram because they can increase or decrease based on the level of need for information a flow. The change in level of need is influenced by national and world events, as well as by new questions or requests for clarification of items in previously delivered products. Each request does not contribute equally to the amount of work, which is influenced by the types of documents or products requested, the complexity of the products, and the turnaround time imposed. All of these factors determine the level of demand placed on the analyst. This section focuses on the process of producing intelligence products. In turn, these changes cause products to be completed and requests of policymakers to be fulfilled. It is important to note that this portion of the model deals with factors that influence the act of analysis and does not attempt to address methods of analysis. Factors that influence the ability of analysts to produce are numerous and complex, as shown. First and foremost are the capabilities an analyst brings to the task. Another influence is the number and frequency of evaluations and revisions imposed on a work in progress. That a draft of the product must be reviewed and edited by a number of others places variable constraints on the time available for creating the original draft. This factor increases in significance when the product requested has a short deadline. Political and cultural values of the organization also have an influence, usually constraining. The weight of these influences will vary depending on the experience of the analyst. To become usable, the data must go through steps that are influenced by a variety of other people, organizations, systems, and technologies. This process is represented by the stock and flow chain that appears across the middle of diagram. Data are collected from a variety of sources, represented by the INTs converter. The ways in which accumulated collected data are converted to the stock of available data are influenced by internal research demands and specific collection requirements imposed by analysts, policymakers, and others. Once the data are processed and put into an agreed format for use by intelligence producers and consumers, they add to the accumulation of material that affects the ability of an analysts to produce. The accumulation of completed intelligence products, which is represented as a stock, is not in practice an end-state for analysis. A customer may respond to a delivered product by levying additional or revised tasking. In all instances, this information influences the level of need for policymaker requirements and causes the process to begin again. Each iteration of the process is different, not because the steps in the process change, but because those responsible for carrying out the steps have changed as a result of their participation in the previous run. These changes can include a greater level of experience with the process, with the customer, with the topic area, or with the quirks of the organization and its processes. The changes are a manifestation of the concept that the system is greater than the sum of its parts. Findings Based on Systems Analysis Systems analysis clearly demonstrates the defects of the traditional Intelligence Cycle model. To recapitulate briefly, the traditional model merely represents a simple list of steps rather than a dynamic closed feedback loop. In addition, although the steps are meant to be performed by several different actors, the model does not provide useful information about what each actually contributes to the cycle, nor does it accurately represent the path a request takes as it is addressed. Another problem with the traditional model is that none of its features help identify ways of developing a consistent product. For example, there is no allowance for a statement of objectives or for any formative or summative evaluations to check that objectives have been met. On the other hand, the model that resulted from a systems analysis provides a more complex view. That model shows cause and effect, and it shows what other elements have an impact on the development of intelligence products and how and why elements depend on other elements. These advantages of the systems model are clearly apparent in considering the role of analysts in production, a crucial element of the cycle that the traditional model all but ignores. The systems view also makes us aware of a less obvious fact that is critically important to a discussion of analytic failure. When the proportion of external factors to internal factors is as unbalanced as the systems model of the Intelligence Cycle demonstrates, the causes of stress in the analytic environment increase, as does the possibility that stress will occur. In such a high stress environment, where the critical person is responsible for delivering a product whose development relies on a great number of factors beyond his or her control, there is greater risk of error, with an increased likelihood of incomplete or incorrect products. Tendencies to use shortcuts, to avoid creative thinking, and to minimize the perceived impact of certain events or actions become more apparent in this situation, especially if their implementation means reducing the workload and the stressors. Results of working in such an environment can include increased personnel turnover, missed or undervalued information, lack of attention to detail, decreased motivation, and a lack of creativity in approaching analysis. Moreover, with analysts so central to the process, their actions may have a widespread and, thus, powerful influence on the entire system. This change can be positive or negative. Given the number of elements influencing the analyst that are out of his or her control, however, it is unlikely that the changes would positively affect the quality, accuracy, and number of intelligence products created. Recommendations Revisit the traditional intelligence model. The traditional Intelligence Cycle model should either be redesigned to depict accurately the intended goal, or care should be taken to discuss explicitly its limitations whenever it is used. Teaching with an inaccurate aid merely leads to misconceptions that can result in poor performance, confusion, and a need for unlearning and reteaching. If the objective is to capture the entire intelligence process, from the request for a product to its delivery, including the roles and responsibilities of Intelligence Community members, then something more is required. This should be a model that pays particular attention to representing accurately all the elements of the process and the factors that influence them. The use of simulation allows us to determine flaws in the system that basic informational models cannot address. A simulation moves the image of the Intelligence Cycle from a picture that selectively and indiscriminately illustrates a series of events to a holistic and realistic representation of events, responsibilities, processes, and their impact on each other. The simulation of the Intelligence Cycle developed for this analysis is merely a first step. Further work should be done with it to validate the representations, test for vulnerabilities, predict outcomes, and accurately recommend changes. The systems model reveals a serious imbalance in the work processes analysts can and cannot control.

Chapter 9 : Best Simulation Software | Reviews of the Most Popular Systems

AnyLogic is the only simulation tool that supports Discrete Event, Agent Based, and System Dynamics Simulation. Learn more about AnyLogic You have selected the maximum of 4 products to compare Add to Compare.

Cool Smartphones Palkesh Jain, Senior Staff Engineer, Qualcomm Keeping a smartphone from overheating is becoming more challenging as increasing numbers of transistors and devices are made to fit into a small, sleek design. Qualcomm engineers have developed a way to use simulation to create a smaller model of the power sources in a smartphone. This model can be solved in a fraction of the time of a full thermal analysis, so that they can look at more operating scenarios. The goal is to create a dynamic power management strategy to selectively direct power where it is needed and keep temperatures down. High temperatures can reduce battery life and accelerate the degradation of interconnects and devices. In addition, a feedback loop can occur in which high processor temperatures lead to high power consumption, which in turn leads to additional temperature increases, in an endless cycle. So smartphone manufacturers must find ways to keep their phones cool. One solution is to develop a dynamic power management DPM strategy that selectively turns off or reduces the power to certain processors until they cool below a specified temperature. DPM strategy requires distributed temperature sensors around the device, especially at critical locations like processors, cameras and antennas. Optimizing a DPM strategy to prevent overheating while maximizing the functionality of the smartphone requires simulation. Smartphone layout Traditionally, Qualcomm has used a full CFD analysis to investigate the transient thermal flow in a smartphone design and investigate possible DPM strategies. But because a full CFD simulation continuously solves for the complete temperature and flow field throughout the smartphone, investigating a single DPM strategy using this method is time-consuming. So Qualcomm engineers began exploring a reduced-order model ROM based on linear and time-invariant LTI systems and a state-space model that could be solved by simulation in a fraction of the time. The data generated by Icepak was used by the integrated multidomain systems modeling tool, Simplorer , to create a state-space model â€” a form of ROM. Simplorer then solved this simplified model in a fraction of the time required for a full CFD method. Time invariance means that whether an input is applied to the system now or sometime in the future, the output will be identical. Most importantly, if two LTI systems have the same step response to a given input, the two systems behave identically. In this case, the two LTI systems are said to be equivalent. If Qualcomm engineers could show that the thermal model generated by full CFD simulation and the smaller statespace model were equivalent, solving the much simpler state-space model would be equivalent to solving the full thermal model using CFD, in a much faster time. These variables are called state variables, and together they define the state space of the system. In a state-space model, knowing the values of these variables at an initial time, along with any inputs to the system at later times, is enough to predict all future states of the system, including outputs. Because the number of state variables is orders of magnitude less than the number of cells in a full CFD analysis, a simulation run using a state-space model can be performed much faster. Under typical operating conditions, such a thermal system can be approximated as an LTI system. These five power source inputs require five Icepak simulation runs, using its parametric capabilities. Using the step response generated from these Icepak simulations, Qualcomm engineers then performed some mathematical calculations to prepare for creating the state-space model, including: Calculating the impulse response from the time derivative of the step response. Sampling the impulse response curve. Performing a fast Fourier transform FFT of the sampled impulse response. Using the low-frequency portion of the FFT and scaling it in both coordinates to get the sampled Fourier transform of the impulse response. Performing vector fitting to obtain the poles and residuals of the transfer function of the state-space model. Extracting the state-space model from the transfer function using Simplorer. After the state-space model was created, engineers applied a constant power of 1. A system-level thermal simulation produced nine outputs corresponding to the junction temperature of all the processors and sensors in the smartphone: Setup to capture step responses using parametric analysis in ANSYS Icepak A full CFD run on the complete smartphone model had 1 million computational cells and took two hours to run on eight compute cores. The results of the system-level thermal run on the state-space model with only five inputs and nine outputs took 20 seconds on one compute core. A plot of the two runs shows almost identical results, verifying that the reduced-order state-space model was the equivalent of the full CFD model â€" an important conclusion, as discussed above. For the published study, they used a two-point hysteresis element with two power inputs and two thermal outputs to study the DPM of one of the main processors. Setting up a lower temperature limit of 98 C for the output and an upper temperature limit of C, they used Simplorer to simulate a DPM strategy, turning on the power at 1. At the same time, the dedicated processor was simulated with a temperature window of 40 C to 45 C and a power input range of 0 watts to 0. The results of the simulation showed that the main processor never reached the upper temperature limit of C in this scenario. The dedicated processor, however, did exceed 45 C. It was never turned back on because the heat from the main processor never allowed the temperature of the dedicated processor to go below 40 C. Ideally, once engineers have found the optimal power-on duration, they can optimize the chip only for that duration. Alternatively, if a temperature limit is exceeded on a critical power source on the chip, it can be set to a lower frequency and perform at a reduced workload without completely shutting down. The framework developed can predict the heat dissipation and the location of hotspots under a certain workload, sounding the alarm when temperature limits are exceeded. There is a one-time cost in making the reduced-order model, but once it is available it enables engineers to explore a lot more what-if conditions. Because the state-space simulation is a factor of 2, faster than a full CFD run, they can run many more simulations to fine-tune the DPM of all the power sources in a smartphone. Even though this test case used only five power sources, it will be possible to create a state-space model containing the more than 50 power sources in a working smartphone, and use the integrated system modeling features of Icepak to develop a DPM strategy that may reduce the power input to a specific source but never turn it off completely, so that the phone will retain full functionality, if perhaps not at full speed. By keeping smartphones cooler, simulation will extend their working lifetimes, even as more features and multitasking capabilities are added.