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Proceedings of the 1984
Winter Simulation Conference
S. Sheppard, U. Pooch, D. Pegden (eds.)

PRACTICAL BENEFITS OF ANIMATED GRAPHICS IN SIMULATION

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Recent years have seen the emergence of graphics tools for simulation. These add to the basic representational facilities of the simulation technique, features enabling the construction and driving of animated color mimic diagrams. The paper considers the contribution of such tools - do they lead to real benefits or are they luxury toys?

INTRODUCTION

(Scene : The Plant Manager's Office)

Plant Manager — "We still have some key questions to resolve on our expansion scheme."

Development Engineer — "Which do you think are the most pressing?"

PM — "Several – but the number of cranes we need to buy must be top of the list; there is such a long lead time."

DE — "We made an estimate based on the target plant output, the average crane speeds, allowance for maintenance, and so on."

PM — "Yes, but we agreed that a better assessment than that was necessary; cranes are costly and important items! That's why we briefed a consultant to give us a simulation model to help, with this and the other questions. He's due here shortly with his first progress report."

DE — "Simulation has a lot to offer, it always seems to me. The idea of being able to try ideas out in advance is very attractive. And all without investing capital or disrupting operations! But I'm still not altogether comfortable with using simulation."

PM — "Oh, why not?"

DE — "Well, I guess it's because I have to take so much on trust. I have to believe that the computer model the consultant builds really does represent the plant we described to him. And represent it well enough to predict the performance of our development options."

PM — "That's what we pay these guys for!"

DE — "Yes, sure; but it's a question of confidence. Can I build the financial case on his figures? When his model comes up with surprising results, should I really act on them?"

PM — "It may be the surprising results that are the most valuable to us, of course."

DE — "True – if we can believe them. It's our plant and future on the line!"

Secretary — "Excuse me; your visitor has arrived."

PM — "Fine; show him in."

(Enter Consultant)

PM — "Good morning, Bill. Good to see you again so soon. You'll remember Ed Grieves, our Chief Development Engineer?"

Simulation Consultant — "Of course. Good morning, Ed."

DE — "Good to see you, Bill."

SC — "I wonder if you can give me a minute to bring some equipment in."

PM — "Sure thing. I'll get my Secretary to organize some coffee while you're doing that."

DE — "Not brought our model, have you?"

SC "That's right. I'd like you to watch it."

DE (surprised) "Watch it?!"

(Pause while Consultant brings in micro-computer and graphics terminal, and powers up.)

PM "Now, what's this?"

SC "I mentioned when we first met that I would use a new simulation tool in this assignment. This is it. And I want to run my first version of your model for you, to see that it matches your plant satisfactorily."

DE "How are we going to do that?"

SC "What I've brought are a micro-computer, which runs the simulation model, and a color graphics terminal, to display an animated mimic diagram of what the model is doing. While the model is running we will be able to interact with it - to freeze it, to change parameters, to change the part of the model we are watching, ..."

DE "Hold on. You're saying that I can check for myself that the model is OK? ..."

SC "That's right."

DE "...and I can change parameters for myself and watch their effect?"

SC "Right again."

PM "OK then, let's see it go."

SC (at the terminal keyboard) "I'm starting a run of the minimum scheme you described to me. We can then add further equipment or change operating times from that basis."

(Diagram of the plant comes up on the screen. Model starts running.)

PM "That's an aerial view of the plant with the basic new equipment alright."

DE "And I can pick out the trucks, cranes, and other mobile items. Moving too!"

SC "Let's watch it for a while and see if it's a good model."

(Pause)

DE (pointing at the screen) "Why does the new crane keep waiting over here?"

SC "I understood that it would not start a new job if the feeder unit would require it within 5 minutes."

DE "Sure, that's normally true - but not if it will delay a despatch point."

PM "But that shouldn't happen very often."

SC "Remember that this is your minimum scheme. It's happening more often with that configuration. I'll change the rule."

DE "Other than that point - that's the way the plant goes."

SC "I've carried out a couple of other runs myself. One cuts back

to the existing plant configuration, to see if the model behaves like you experience now; and one with three cranes, since you placed a lot of emphasis on that issue when we first met. I've got the printed results from both runs here."

PM "Do you still have print-outs, then; even with these pictures?"

SC "Indeed. You need to run the model for a length of time to get a sufficiently accurate prediction of performance - except where a conclusion is blindingly obvious from the graphics. You therefore still need to collect data and analyse it."

DE "I can see that we mustn't jump to hasty conclusions just from watching the pictures for a short time."

(The Manager and Engineer look at the print-outs.)

DE "Why doesn't the third crane make more difference?"

PM "That's puzzling me, too."

SC (back at the terminal) "Let me show you. Let's stop the model and put in a third crane."

PM "This is using the operating rules that we agreed?"

SC "Correct. Now watch how the cranes interfere by the feeder unit."

(Pause)

DE "I understand. But we can get round that for a few bucks!"

PM "You'd better look at that in detail then, Ed."

SC "And we can test it out in the model."

DE "That's a good start to our project, Bill."

PM "And it's not taken long to get to this stage, either."

SC "No. I benefit from the graphics, too. I can more quickly see where the model is going wrong or not behaving as I intended."

PM "OK then. Ed will be in touch shortly with the details of the new addition."

SC "In the meantime, I have some work to do on the statistical reporting of the model."

PM "See you soon."

SC "Goodbye. Have a nice day."

PM/DE "Bye, Bill. You too."

(Exit Consultant with equipment).

THE ADVENT OF GRAPHICS

In the late 1970's developments in micro-computing technology made economic color graphics equipment available. One field to take advantage of this was computer simulation.

Prior to that time simulation could only, on the whole, be a 'black box', constructed by a suitable expert and thereafter fed with data to produce tabulated results. In exceptional cases, special visual displays were constructed and linked to computers - manually or electronically (1). These were costly,

inflexible, and/or slow to use. Color graphics overcame all these drawbacks to open up the field of visual interactive modelling.

Not that simulation is the only beneficiary. Visual interactive modelling has wider application (2).

IMPLEMENTATION IN SIMULATION

The pioneering and leading packages in this field are WITNESS™ and SEE WHY™.

Taking WITNESS as an example. This enables an accurate computer model of a real-world area to be constructed, together with color pictures portraying that area in ways that the user can readily understand.

The graphics is distinguished from the simulation: the latter provides the model; the former a manifestation of the model (simulation being a dynamic representational tool; the WITNESS graphics are animated).

But having distinguished the graphics/mimic diagrams from the simulation modelling, what is the contribution of animated graphics? The real representation of the problem is carried out by the model - incorporating the structure and rules governing the system. The 'simulation' which formed the Introduction to this paper pointed out that statistical results are still essential.

So what are the practical benefits of graphics?

BENEFITS?

The opening scenario illustrated the several very real benefits that have been experienced by users (that is, clients as distinct from model-builders) of simulation with animated graphics.

User Confidence

With graphics the user can see the model and relate it to his problem area. He is justified in being suspicious of a 'black box' of code manipulated by an 'expert'.

The very first application of WITNESS involved the addition of graphics to an existing simulation model. This resulted in a user identifying a previously undetected fault in the representation. This fault had survived written model descriptions and specifications because of a misunderstanding of a form of words.

A wide case history (albeit mostly unpublished) demonstrates that models with graphics have user confidence to a high degree. As a result the information generated by such a model is more likely to be acted upon.

User Understanding

Similarly, experience has shown that simulation users understand the 'messages' of a simulation run much more clearly through animated graphics.

It is worth noting that the nature of the mimic diagram, in particular its similarity to the real-world layout, has a real bearing on user comprehension (3). Schematics diagrams are less effective.

User Involvement

A result of the above benefits is increased enthusiasm on the part of users. This is manifest in two ways. Firstly, within a particular problem, the model is drawn into more issues and into the decision making process. Secondly, more widely, the user catches a vision of the potential of the tool and identifies more applications (and recommends it to others).

User involvement in a particular simulation run, encouraged by the graphics, must be matched by interaction facilities enabling the user to control the course and content of what he/she sees. (And there must also be the caution to avoid hasty judgements based on relatively brief visual observation of a model in action.)

Development

Graphics provides a further dimension to the verification of simulation models. This results in the identification of logical faults more speedily. Indeed it has been argued (4) that some logical faults cannot be identified other than visually, ie. through some mimic arrangement.

The graphics functions of a model also place a discipline on the model builder. He is discouraged from short cuts (with short-term benefits but longer-term dangers) because the model's actual behaviour will be watched by the user.

CONCLUSIONS

Simulation is about adequate representation. The addition of graphics is about adequate communication.

Simulation model building requires a tool of the right power. Animated graphics requires a tool with the right presentation.

The appearance of visual interactive simulation may lead to remarks likening it to video games - but it is no toy. It is a practical and valuable tool.

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TRADE MARKS