Discrete Entity Simulation in Industry

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***Abstract* - Discrete Entity Simulation has been available to Industry now for many years. Industrial users tend to purchase a proprietary software package. The way that these packages are chosen can be irrational. Subsequently, the way that these packages develop is dependent amongst other things on the feedback from the purchasers and the new ideas coming out of the universities. However many of these ideas can find it difficult to overcome the power of the customer, often because the customer does not know or understand what is being offered to them. The lack of understanding behind this, blocks the "Route To Use" for many ideas. This paper set out to assist in opening up communication channels by discussing how the Discrete Entity Simulation technique is used and applied in a single company with a look at the possible gaps in the research effort.**

Keywords – discrete, entity, simulation, industry

I. INTRODUCTION

A. Background

Simulation in Industry tends to be carried out by one of four groups of people:

- In House Specialists
- Independent Consultants
- Consultants from a Software Supplier
- Universities

All of these groups need to be supplied with information about the available software tools and their usability.

Simulation is a young technique that whose development is being governed by new ideas from the universities and demand from the users.

B. Simulation in Industry

There are many types of simulation used in a wide variety of ways throughout industry, but it is true to say that the technique is not used in all the areas that it could or should be.

It is common for an industrial user of the technique will purchase a proprietary product to carry out simulation projects. We do this for a variety of reasons; most commonly to avoid the nitty gritty coding that goes with doing it yourself. So, while it is very rare that an industrial user will go for a tool or language that allows the greatest flexibility, there is a potentially huge market in Simulation Software Products.

The choice of which product or products to use has become a major "barrier to use" of simulation in itself as individuals in each organisation try to decide what product to buy and which offer good value for money.

Research is definitely needed to study the available software packages, identify what they are good at and compare their features. This research needs to be kept up to date as the market evolves.

When this research has been done in the past it almost always looks at the immediate practicalities of using the software. While this may be of immediate interest, they are other things that need to be considered.

The very act of purchasing the software and paying the maintenance charge on it, means that the user is entering into a long relationship with the supplier. The quality and therefore the usefulness of that relationship is very much dependent on there being more than a clever technician or salesman answering the phone occasionally back at head office.

There needs to be a proper help desk, manned at hours that are convenient to the user not the normal office hours of the Bombay programming team. The people manning the help desk should not be the software authors. Any supplier worth their salt will be carrying out consultancy work. Those consultants are often the best people to place on the help desk. They truly understand what you are going through.

There needs to be an independent and lively user group. These are the people who are going to take time out of every project by teaching you the tips and tricks. These people understand how proper project management can help you and show you how to apply what they have learned. These people have spent years inventing the perfect wheel, they can lend it to you! Just think of all the time you will save by not inventing another wheel.

There needs to be an open and formal method of agreeing the new features when upgrading the software. There are three drivers to upgrading:

- The competition are getting ahead and the software needs to catch up by inserting facilities into the software that the opposition has.
- The users are pressing for changes.
- There are new ideas bubbling up that will put the software ahead of the competition.

The balance between these pressures needs to be understood and to be open. If a major upgrade comes out introducing features that you are not interested in, while you are waiting for something important, there is something wrong.

II. "ROUTE TO USE" FOR NEW IDEAS

As can be gleaned from the above the "Route To Use" for new ideas is most commonly through the main software suppliers. This means that the relationship between the software suppliers and the universities has to be good for the system to work correctly. This works well when there is a tradition of universities and industry working together. Where this tradition is lacking the "Route To Use" for new ideas can be more tortuous.

This can be demonstrated by looking at some suppliers, picked in a rather random manner, that are working based in other parts of the world;

A. USA

It is significant I think that the main simulation conferences take place in the USA. While still dominated by the Universities it is significant that this years WinterSim includes a track for industrial examples.

A good example company here is AutoSimulations, but Arena would have done just as well. There is a good working relationship in Utah with the University with people, money and research flowing appropriately. Despite some problems with the most recent release, the company is still ahead of the herd for material handling simulations. Its recent acquisition of SIMUL8 shows a determination to broaden its appeal

B. Northern Europe

I have chosen Enterprise Dynamics, where the main use of the Universities is through recruiting. This allows the new employee(s) to bring new skills and knowledge. It needs a Company with an open culture to make this work however. A looser relationship perhaps but the company still is open to new ideas and implements them.

In the meantime, use of the software will be restricted while 4DScript remains in use. We have enough computer languages in the world without another one that does not bring anything new.

C. United Kingdom

The UK suppliers seem to be in a permanent state of trying to catch up. There would appear to be few firm relationships between industry and academia, in the discrete entity world at least.

III. SOME OUTSTANDING PROBLEMS

The number of potential research areas are vast. I have chosen a few completely at random that came up in conversation at a recent industrial simulation conference. There is no scientific analysis for this choice at all and no literature search to prove that nothing has been done on them! What I can say is that most packages do these very badly.

A. Public Behaviours

- Corridors – This covers Entities with different properties on a movement system with just a few rules. One of the properties of the entities are that can overtake each other.
- Roads – similar to corridors but the rules on the movement system are more strictly enforced. This is a hot issue at the moment with traffic management offices all over the world doing their own thing and getting very different results.

B. Flows

- Liquids and Gasses – very few packages bother with liquids, those that do assume that the pipe has complete control over the content. In reality the rules covering the flows of most things at actually well understood but consist of more than the value printed on the side of the pump or the pressures in the source and target vessels.
- Bottles and Jars – Mass flows and collision speed limits are currently ignored. Where are all the photo eyes, tilt switches weight sensors?

C. Experimentation Tools

Most packages are shockingly bad. Only AutoMod even approaches a standard.

This is the purpose of building a model and yet it is completely ignored by most software suppliers.

D. Fragmentation

Software is broken up into modules, packages, entities, processing is split from graphics, movement systems are split from logic etc. I don't want your modules: I want it to all fit together in one usable whole, seamlessly. Sometimes we spend more time managing the tool and the "Work

Around" that are forced to use, than we spend on solving the problem. Some suppliers seem to have forgotten that simulation is not an end in itself.

E. Usability

We have got used to Microsoft levels of intuitive software, everybody else needs to catch up. When you first start up most packages, there is not even an obvious place to start. You can say that for Microsoft, you may have to click the start button when you want to shut down and stop, but at least the first button you click is well labelled!

IV. SOME RECENT PROJECTS

Simulations are built for a reason. Usually there is more than one reason. However there is often a predominant one, so the following examples are allocated accordingly.

A. To Gain Insight - Why does it do that?

A1. The Model Warehouse: This model was built to exclude the extraneous noise that goes on in any complex operation. The question was:

"What is the practical capacity of the machinery when the human side is working and why?"

The model showed what the limiting factor was and why and then was able to show what the effect of removing each limit in turn was.

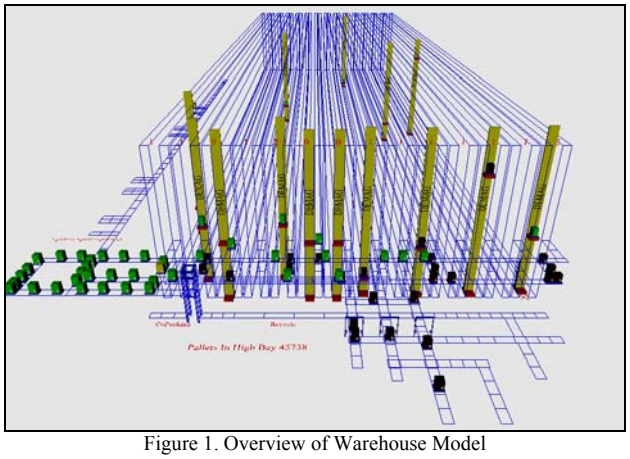

Figure 1. Overview of Warehouse Model

B. Receive Foresight - Will it really do that?

B1. The Blending Model: The purpose of this series of models was to try out different ideas for the storage of raw materials at the start of a blending process. First a model of the present system was built and validated. Then a model was built for each idea. This allowed the balance between capital cost, production flexibility and size of work in progress to be examined.

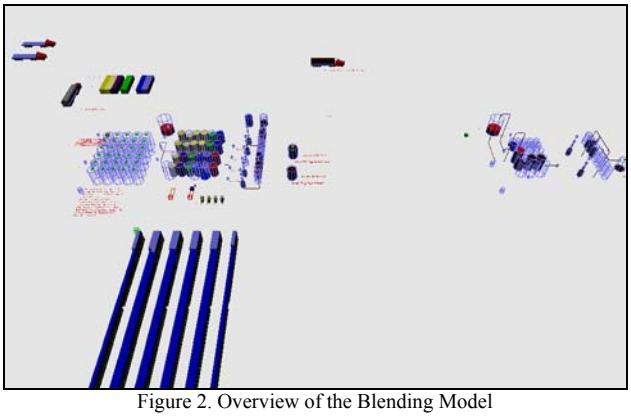

Figure 2. Overview of the Blending Model

C. Understand Efficiency – How do I improve that?

C1. The Branston Model: It is not unusual for the services to a production area to be restricted in some way. Different services restricted in different ways. This can make the scheduling of work very complex. This model was built to examine how the services affected productivity. When that was understood experiments were carried out to identify the changes that had the greatest effect on productivity.

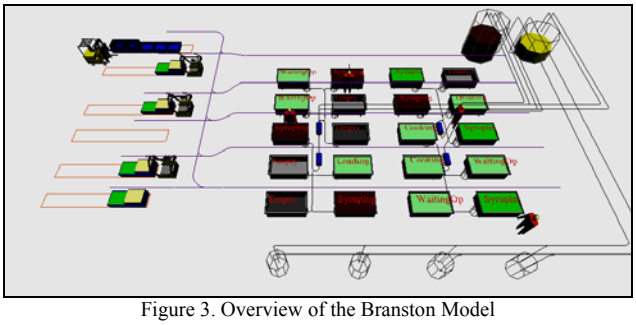

Figure 3. Overview of the Branston Model

D. Compress and Expand Time

D1. The Wrapping Model: This model of a chocolate bar wrapping hall was built in order to decide the operating algorithm of a single piece of machinery, the work in progress buffer.

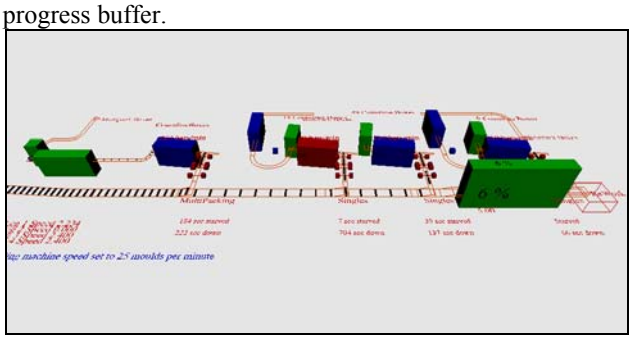

Figure 4. Overview of the Wrapping Model

However carrying out the work raised questions about other areas, in particular the way that the incoming bars controlled the speed of the wrapping machines and affected their breakdown rates. By running the model very slowly and very quickly, these effects were easily seen.

E. Gather Data Better Faster

E1. The Material Movements Model: Sometimes a system is just too physically big to walk around easily. On top of that, the use of a single statistic to describe behaviour can be misleading. This model was built to show a large layout on one screen and to take properly measured speed figures and turn them into stochastic statistics. This lead to a better understanding of what was happening in the system and better methods of managing it.

F. Understand the Information

F1. The Gas Flow Model: In this model all the individual factors are well understood, the how they work together is less so.

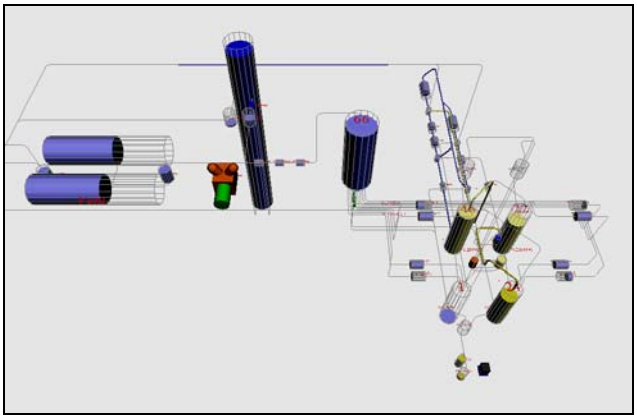

Figure 5. Overview of Gas Flow Model

Once the model was completed, new ideas and uses for it were found.

V. CONCLUSIONS

Simulation is a young technique that has a long way to go to receive universal appreciation. It is still emerging from its parents home in operational research.

Academia has a major role in making the technique successful.

Biography

Neil Bowerman worked in various capacities as Management Information Analyst since 1988.

Responsibilities: Acts as an advocate for and a provider of Discrete Entity Simulations inside Nestlé UK.

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