In business

When swarm intelligence beats brainpower
By Tom Lloyd *(Filed: 06/06/2001)*

WHEN the work of a management consultant is mentioned in a major article in Scientific American, you can be sure something significant is up in the science of business.

Vince Darley, head of EuroBios UK (the London end of the BiosGroup of Santa Fe, New Mexico), earned his Scientific American reference for a scheduling model he devised with David Gregg, of Unilever.

They broke with traditional approaches to scheduling by getting software "ants" to lay pheromone trails (just like real ants) and find the best locations for and movements between the storage tanks, mixers and packing lines in a large Unilever factory.

Scientists have long been fascinated by the ordered behaviour of bees, ants and other social insects, but this was one of the first times that "swarm intelligence" had been used successfully to address a notoriously difficult business optimisation problem.

It will not be the last. Similar approaches are being developed by France Telecom, BT and MCI Worldcom for routeing traffic through their telephone networks, and EuroBios UK is using pheromone-laying software ants to optimise routes in Unilever's Myhome domestic cleaning and laundry business.

Swarm intelligence is one of a number of phenomena that have been studied by complexity scientists for many years, and from which powerful management tools are now being derived. Other companies, including i2 Technologies, of Irving Texas, and Artificial Life, of Boston, Massachusetts, are also applying complexity principles to business, but BiosGroup's credentials are arguably the most impressive.

It is a joint venture between Cap Gemini Ernst & Young and Stuart Kauffman, co-founder of the Santa Fe Institute for the study of complexity, and one of the world's leading complexity scientists. Since its formation in 1997, Procter & Gamble and Ford Motor Company, both clients of BiosGroup, have also become shareholders.

EuroBios UK is using agent-based models (consisting of software agents that interact with each other to simulate complex business processes) to analyse operational risks at

the Invensys group. Financial risk is well understood, but as the Basle Committee on Banking pointed out and as the huge losses at Long Term Capital Management, Barings and NatWest Markets demonstrated, an understanding of financial risks provides no protection against human error and inadequate controls.

Agent-based models reveal the nature and scale of operational risks, and show how different parts of the system interact. Mr Darley says: "We took Invensys' ranking of risks, fed it into our model and generated a very different ranking. "A high level of organisational complexity was way down their ranking, but high up in ours.

"Businesses cope with a lot of risks quite well. The problems come with risks that propagate throughout the business, and have knock-on effects. Such non-linear interactions can generate extreme events. Agent-based modelling can identify these risks, so that steps can be taken to control them."

Another potential EuroBios UK client has a huge warehouse full of cardboard that costs £500,000 a year in rent and ties up a lot of working capital. The size of the stock reflects the packaging company's lack of trust in its factory to deliver large orders quickly enough to satisfy major customers.

Mr Darley says an agent-based model of the business could quantify the risk of running out of stock and show how better communications could substantially reduce warehousing costs and working capital. He and his team are using a similar, agent-based model to help Unilever develop its new Myhome cleaning and laundry business.

It is an intriguing venture for Unilever because it forges direct relationships with consumers, but it is a complex business, unlike anything the Anglo-Dutch consumer goods giant has tried before. In the model EuroBios UK has developed for Myhome, the system's agents are customers, cleaners, supervisor/drivers (who check the work of cleaners and ferry them between jobs) and a special class of unsupervised, self-driving cleaner.

The model shows how sensitive the economics of the business are to such variables as the number of cleaners supervised by each supervisor, the number of self-driving cleaners, the number of services clients buy and the proportion of clients willing to give Myhome a key, so that cleaners can do the job when it suits their schedule.

The model is pregnant with implication for pricing strategies and, combined with the ant-based scheduling system, can also generate useful information about the most attractive areas to expand into, once Myhome has proved its worth in its pilot areas of Wandsworth and East Sheen in Southwest London.

Complexity-based tools will become increasingly

important as the complexity of business grows, with growing connectivity. Their power lies not in their ability to solve complex business problems, many of which are theoretically insoluble, but in their ability to get closer to solutions than traditional approaches.

The famous travelling-salesman problem (finding the shortest route between a number of cities) is actually insoluble, because the number of computational steps needed to solve it grows faster than the number of cities. But ant-based models using artificial pheromones can get very close to an optimal route.

Mr Darley admits that complexity tools can seem a little threatening to people nurtured on mechanical models of business, but he believes they will become more popular as their power becomes more obvious. "In areas like the supply chain they encounter some resistance, because you have to surrender control to make them work.

"That's why we begin with models that help people to make decisions. We haven't found anyone yet who will let us put agents in to run their systems, but eventually, the agents themselves will be trusted enough to make decisions."

BiosGroup has already started turning its models into operational tools of this kind. Late last year it launched its first software package - an internet market tool called MarketBrain. But for the time being most of the complexity models and tools deployed by consultancies such as BiosGroup will continue to be individually tailored for each client.