

Sustainability Matrix

A short story by [Trevor Hopkins](#)

The truly unchanging thing about university research, at least in engineering and the applied sciences, is the endless quest for research funding, grant money and miscellaneous financial support. Research apparatus of all kinds – especially, these days, leading-edge computer equipment – is hugely expensive and undertaking any kind of original – or at least publishable – work in these areas inevitably requires a substantial investment in state-of-the-art machinery.

Even more importantly, acquiring a big research grant is an exceptionally good way of gaining kudos in a university. It is a considerable source of clout, even real power, over one's colleagues in the Schools and Faculty, and an essential pre-requisite to becoming a full Professor. The ability to offer scraps and titbits – such as occasional access to your machines and facilities – indubitably strengthens one's position of influence over those poor unfortunates who are reliant on crumbs and handouts from the well-funded research group next door.

So it is no real surprise that academic researchers are always on the lookout for The Next Big Thing to fund their insatiable appetite for resources. Right now, of course, that Big Thing is on the intercept of green politics, economic and cultural globalisation, and the biophysics and geophysics of climate change.

When one looks back at the last century's history, the doomsayers of yesteryear were, it seems, always wrong. Remember all that hoo-ha about the threat of Nuclear War and World Peace? While the world is still manifestly not an entirely peaceful place, no-one seriously expects World War III to break out any time soon.

Or take world hunger: it is not particularly well-known that the planet already has enough food for all of the population, a benchmark we quietly passed some time in the 1970s. Admittedly the foodstuffs are not always well-distributed, with rather too much being consumed by overweight westerners. Worse still, much more than one might have liked is still wasted, either because of unnecessary purchases

from supermarkets or spoilage from vermin and lack of refrigeration in African villages.

Nevertheless, the principal observation remains: the dire predictions of history did not come to pass. Of course, the wilder forms of these prophecies did indeed result in changes to both public policy and personal perceptions. On population growth, for example, the rate of which has slowed in recent times: in some cases, because of fairly draconian government (like in China) but elsewhere more so due to changing social expectations.

Similarly, it has been deliberate policy of many Western governments, especially in the period since the Second World War, to become self-sufficient in food for political reasons. This is still an underlying principle of the European Union's infamous Common Agricultural Policy, with its unbalancing effects on the economics of crops and harvests the world over.

It is not easy to get an overall picture of the effect of policy changes in the interrelated areas simply because of the large number of complex interactions. So, to give you an idea of just what can be discovered with sufficient application, I need to introduce you to Doctor – well, here I better refer to him only as Dick, for reasons which will become apparent – who was a Senior Lecturer in the School of Computing at my University.

Doctor Dick was a man in his early fifties but, thanks to some quirk of genetics, could easily have been mistaken for someone ten years younger. He was of only medium height, but with unusually broad shoulders which he emphasised by habitually wearing well-tailored suits in an environment where the typical academic staff member rarely wore anything more elaborate than sweatshirt and jeans.

Dick had managed to avoid running to fat in his later years, although exactly what exercise he took was always something of a mystery. He had a thick head of hair, even now barely greying at the temples, and a bushy moustache that gave him a passing resemblance to Mario the Plumber. He displayed what he probably liked to think of as an affable, sociable disposition, one happy to stop and chat to anybody. To anyone who knew him well, in fact he came across as a bore, one who was likely to buttonhole you with gossip and triviality in the corridor.

Dick enjoyed a certain reputation with the ladies – not usually students, if only because there are even now very few female students in Computing – but several of the secretaries and administrative assistants from the Faculty seemed unable to resist his blandishments. These affairs never lasted long, presumably as the lady in question tired of his manner and mannerisms, but long enough to ensure a certain amount of – well, jealous, I rather think – speculation that his attentions to the female of the species was the missing exercise that kept him fit in middle age.

This same characteristic allowed Dick to be a successful salesman, at least outside the School, of the kind frequently referred to in the corridors as a bullshit merchant. He had not yet made it as a full Professor and was not personally popular in the School or Faculty, having been the butt of impudent remarks like “Dick by name and Dick by nature”. Neither had he, until now, managed to acquire the kind of seven-figure research grant which these days more-or-less guarantees the creation of a Chair in the University of your choice.

Nevertheless, he had kept up a steady stream of not-particularly distinguished contributions to the state of the art, and had managed to keep himself – and a tight coterie of research assistants and postgraduate students – in paid employment. This work had been funded by a series of minor research grants and University awards, the latter being issued grudgingly and frequently against the opinions of the more senior members of the School.

The topic Doctor Dick had been working on for many years was self-assembling computer models, although he personally promulgated the rather grander title of Synthetic Computational Modelling with Semantic Matching and Heuristic Optimisation.

Following the trend, Dick came up with the idea of applying his pet research interests to the confluence of interests around climate change: not because he particularly believed in Global Warming, or disbelieved it, for that matter, but simply as a trendy vehicle of his particular flavour of computer modelling. Such modelling was notoriously demanding of processing power, and Dick had claimed for many years that his research was serious hampered by a lack of machine time and resources. For decades, he had energetically applied for research funding from every plausible source and, if the local gossip is true, from quite a few unlikely ones, too.

It was to the considerable surprise of most people in the School and – I suspect – to Dick himself that he managed to get a major Combined

Boards grant from the UK Engineering and Physical Sciences Research Council together with a consortium of European Union bodies. Dick, I feel sure, must have applied to the Combined Boards as a matter of course, undoubtedly recycling portions of previous, unsuccessful proposals to rapidly assemble a case for support. The bulk of the grant was represented by the provision of a medium-sized supercomputer and a handful of networked workstations, with just enough left over to engage a clutch of new research associates and post-doctoral Fellows, and even fund a few bursaries for research students.

Admittedly, this was at a time when everyone knew that both UK and EU governments wanted to be seen to be doing something - anything - about global warming, no doubt leading directly to the announcement of an initiative on Climate Change and, coincidentally, a separate one on the Management of Natural Resources.

To the consternation of the senior staff, Dick suddenly became the effective possessor of the most powerful computer in the School. The formal organisation of the Science Faculty rapidly swung into action to perform its core function: that of prioritising the spending of government largess above the petty rivalries of academic staff. So it was not long before both the supercomputer and Dick's coterie of research students were installed in a separate suite of rooms within the School's buildings, just down the corridor from Dick's own office, with access jealously guarded with doors fitted with the latest in keypad locks.

Now of course there are vastly more potent machines for shared academic use - teraflop processors hundreds or thousands of times more powerful than the machinery Doctor Dick had acquired. Nevertheless, just getting a two-hour slot on one of these behemoths meant writing a case for support in itself, completed a massive amount of paperwork and enduring a two month waiting list. By contrast, the new computer - inevitably known as Dick's Tool, with the kind of puerile and bitchy humour so prevalent amongst the really intelligent - could be dedicated to any one task twenty-four hours a day. The new machine was widely understood to be running at or near full capacity from almost the moment it was installed.

My friend Paul was one of Dick's new research students. We had been undergraduates in the same intake year, although we knew each other only slightly then. He was a tall and exceptionally skinny young man, permanently stooped to avoid doorway lintels. He had a large

bony and angular face mostly concealed by curly black hair and a full beard, giving him the appearance of the Tallest Dwarf in Show Business.

Paul, like me, had elected to stay on at the University to start on a PhD, although he had taken up one of the bursaries that Dick's newly-minted academic stature had created. After Finals, most of our peer group had left the University, and he and I had drifted closer. Fairly frequently, when the desire for a little company was upon me, I would call at Dick's laboratory to invite Paul for an after-work drink in one of the back-streets pubs nearby.

On these evenings, I would knock on the heavy steel firedoors, invariably firmly secured by that keypad combination lock whose code was rumoured to be changed daily. I would be required to wait a few moments, and then the door was opened by one or another of Dick's Research Associates. I was never allowed inside the suite of rooms, but I could glimpse diligent work being carried out within.

An array of workstations and graphics displays was laid out on desks in the outer office while the black cabinets of the supercomputer itself could just be glimpsed through the glass doors and partition beyond. As I watched, Paul logged himself off from one of the workstations and gathered his few belongings ready for the short walk to the public house.

It is not my field of speciality, but from my limited understanding – an understanding mostly gained over a couple of pints of beer, it has to be said – Dick's modelling process required three steps. First, a standard model for one particular intellectual area was loaded into the supercomputer. Typically, this would be a model developed by other researchers, and generally accepted as a reasonably accurate representation by others in that research domain – at least judged by the number and quality of papers published.

Academic endeavours around the world have produced a large number of computer models developed for specific fields. To get copies of the programs, a certain amount of negotiation must have been required. I assumed that Dick's charm must have come to the fore and he seemed to be well able to persuade groups in other Universities, especially those in other parts of Europe, to provide copies of their software.

Once the model files were acquired, there was an extensive and very manually-intensive process of matching of each of the variables

in the model against the terms in a hierarchically-structured ontological database: that is, a standardised representation of concepts or “things”. This kind of intellectual drudgery is of course exactly the reason why professional academic researchers engage so many research students.

The second step involved a heuristic process whose details I do not really comprehend, but seem to be some kind of genetic algorithm, to allow the machine to evolve a simplified model – in the sense of using far fewer machine resources – which nevertheless behaved in the same way as the original one. This compressed model would have identical inputs and outputs for all cases tested, and could therefore be said to represent the same system. Of course this optimisation took a vast amount of time on the computer, but after a few tens of thousands of iterations, a stable simplified model would usually have been created.

These first two steps were repeated for models for each of these different areas. From Paul’s account, Dick had managed to acquire integrated models for global climate and weather, for the availability and consumption of natural and physical resources as diverse as oil and arable land, for international economic and monetary systems, and for the dynamics of human population growth. All in all, it was enough to represent nearly all of the myriad global interactions that human beings make on our planet, and vice versa.

The final step was to load all of the Heuristically Optimised models into the supercomputer simultaneously, and allow the Semantic Matcher to combine them in a single matrix, based on the mappings to the standard ontology from the database. This integrated matrix embodied a holistic representation of the combined space, a hugely complex model which might well have been impossible to assemble without the compression that Dick’s approach employed, even on the world’s largest supercomputers.

Now, the well-known computer dictum of “Garbage In, Garbage Out” may well be applied here. The approach required so many bizarre transformations far away from any kind of human scrutiny that it is compelling to conclude the outputs from such a composite model would be rubbish regardless of input. On the other hand, it was certainly the only practical way of getting such a complex composite to produce any kind of comprehensible output, at least with the kind of computational resources continually available to a minor British University research group.

Dick and his merry men – he did not seem to attract female research students – worked away for many months, largely separate from the rest of the School. This met with numerous snide and disparaging remarks, and a high level of general distrust. Even so, there were academic papers written and accepted for publication, which were grudgingly accepted as a useful contribution to the Research Score: the total weight of paper produced by the School and therefore the academic quality rating of the University as a whole.

The published papers following the usual sequence: first, a positioning paper, setting out the objectives and approach, and outlining the techniques in broad theoretical terms in order to establish the earliest possible claim of intellectual precedence and prior art. This seminal work was followed by an irregular sequence of research monographs, conference submissions and the occasional refereed journal paper, detailing specific parts of the whole process in mathematical and often excruciating detail.

Each paper had, as is typical in the outputs of research institutions, a long list of authors, always including Doctor Dick's name – near the head of the list, of course – together with a variable subset of his team. There was nothing truly outstanding in each publication, Paul acknowledged wryly, but each was enough to “advance the sum of human knowledge” as is required by the submission guidelines for academic publications.

Often, a grandiose academic undertaking like this either collapses, unable to deliver on the aspirational results, or else morphs into something almost unrecognisable as some newly-uncovered and exciting aspect expands to consume the entire budget. So it was unusual to hear from my friend Paul that the original objectives were indeed being pursued with very little deviation, and that they were on-track to deliver a successful combined model, although he confessed that one would probably not have realised this from the materials published so far.

I caught up with Paul again just a few days ago. He was looking worried and, unusually, it was he who suggested a quiet late-night pint. I had been working late, struggling with a research problem of my own, and rapidly agreed to meet him in the pub later on. I arrived first, bought the usual drinks for the both of us and I sat for a few moments sipping my pint. Paul arrived shortly afterwards, ducking under the door and looking around the bar in what struck me as a furtive fashion until he spotted me sitting in a quiet corner of the Snug.

He hurried over and slumped into the seat next to me, still looking around the otherwise unoccupied room as if expecting to see someone following him. He grasped his glass as if his life depended upon it, and drank of about half of his pint in one go – most unusual for a serious young man who rarely consumed more than two pints in the entire evening.

Speaking so quietly I found it hard to hear clearly, Paul told me about the state of development of the composite model – he referred to it as a Sustainability Matrix – and that Doctor Dick expected to publish a preliminary results paper very soon. He then leaned forward over his pint and lowered his voice even further.

All variants, Paul announced, of the matrix now executing on Dick's Tool demonstrated an inevitable decline in both global economy and human population – so rapid, he said, that the term “collapse of civilisation” was not too dramatic a phrase. I stared at him for a second, at first not sure whether I had heard him properly, and then for a longer moment while the import of his pronouncement sunk in.

“You mean it's inevitable?” I asked, aghast.

Paul nodded his head, then took another long pull from his drink.

I asked him whether the matrix, the simulation was telling the truth. He looked so serious for a moment.

“I think it is,” he replied morosely, “I simply can't see any alternative.”

He explained that Dick's researchers were trying more variations – the machine was running at full capacity all the time now – and there was a continued investigation to demonstrate coherence with the original models by substituting in turn each of the original full-scale models for the heuristically-refined version. Doctor Dick was desperately worried about finding a hitherto undiscovered flaw in the approach and that they expected academic challenges from many quarters.

“Look, I've got to go,” he said, draining the last of his pint, “There's lots more work to do, and Dick wants to get a paper out tomorrow.”

After my drink with Paul, I wandered back to the grotty terraced house I shared with several other postgrads, alternately musing on what I had heard in the pub and on my own technical problems. I slept

badly, with obscure and formless dreams roiling through my head all night. Finally, I gave up and got out of bed, and was back in the School very early – at least for me.

The route to my own office took me past the double doors which opened into the machine room occupied by Dick's Tool and his team. Something made me look again, some subliminal change in the appearance of the doors made me turn back. The doors were not quite shut and the combination lock was not set.

Gingerly, I pushed open the door. The whole area was entirely empty, and the glass partitions stood open. There were just a few black scuff marks on the floor tiles to show where the supercomputer had stood. The desks were devoid of the workstations Paul and his colleagues had been using so busily only last night, and the filing cabinets stood open and empty. There was no-one around – the whole group must have left, completely, in the middle of the night.

The official announcement later that day, in the form of an "All Research Staff and Students" email from the Head of School, was short and singularly un-illuminating. "By mutual agreement," it read, "the Synthetic Computational Modelling group led by Dr. Dick" – his full name was included here – "has moved to another research institution with immediate effect."

There was no mention of which Institution – I noted that the word "University" had not been used – Dick and his team had moved to. Nor was there any reason given for the rapidity of the transfer or for the lack of any prior announcement.

I was curious to learn more. I tried to get in contact with Paul by email using the School's own mail address, assuming that the Computer Services Systems Management Office would have set up email forwarding as a matter of course. The note bounced back immediately, marked "undeliverable". I accessed the University's online staff and student directory. There was no entry for Doctor Dick, or Paul, or indeed for any of the other members of the group. All references had been completely expunged.

I asked around the other research students and some of the younger and more approachable member of the staff. No-one seemed to know, and indeed few seemed particularly concerned. Rather, they appeared more interested in squabbling over who was going to take over the prime office and machine room space previously occupied by Dick's group.

Finally, I tried the only other method readily available to me to track down Paul – the use of those Internet search engines which seem so adept at pulling up information on the most unlikely of subjects. I just found a few rather stale and generic references to the research work that, thanks to Paul, I was already aware of. In all honesty, I had expected to find an announcement that a “prestige research group” had joined some – presumably foreign – University. But there was nothing: it was exactly as if the entire research group had disappeared of the face of the Earth – or, at least, off the face of the Internet.

I have been forced to conclude that Dick and his Merry men had been co-opted into some secret – and probably Government – organisation, some top-secret Think Tank or advisory body, some establishment associated with climate change or some policy planning group, or perhaps the research arm of some multi-national company with deep pockets and vested interests.

I remained curious, browsing the Web frequently. I was expecting to see, perhaps, a policy change announcement from Brussels or the United Nations, or even Dick’s long-awaited seminal paper on his results, vindicating his modelling approach after all the years of disbelief. Nothing at all, not a peep anywhere on the destination of Paul and Doctor Dick, or on the earth-shattering implications of the Sustainability Matrix.

Over the last few days, googling the same search terms, I have noticed the search produced progressively fewer results referencing Dick’s research output. Right now, there are just a few vague and third-hand references to his modelling approach, more-or-less buried in the noise that keyword searches tend to elicit from the search engines. It is almost as if records were being carefully and progressively deleted.

The realisation has finally been forced upon me: what kind of secretive cabal or international company or government organisation has the kind of clout to extirpate the academic output from a university research group from the collective knowledge of the world academic community? More importantly, I have to ask the question: who or what is preventing us all from knowing the likely impact of the current human occupation of this planet? And, why on Earth are they doing it?

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