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eResearch 2020 interviews Oliver Chikumbo on Smart Cities

At the Michigan State University BEACON Centre, we are looking at working together with social scientists and their tools, to help us decipher "preferences" and "values" of stakeholders most affected by decisions in community-based analyses. We've got social scientists in NZ but we are yet to see their wider involvement in basic science and related decision-making. Just because we engineers build a model doesn't mean that we can automatically elicit decisions from it; we need social and management sciences people to help us build platforms for decision making based on human behaviour manifested via the preferences and values of the stakeholders most affected by the decisions.

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Note that NZ is too small to compete in this research space with the likes of Amazon, IBM or Living PlanIT etc.; there's no way we can catch up as we haven't the money or resources to do so. Instead, NZ needs to become a small part of the emerging global supply chain, contributing those valuable elements that are suited to our capabilities. In this case we will not be losing anything, as we will own what we would have created. What we need to do is to position ourselves as one of the strong links in a larger global supply chain.

I agree with Shaun Hendy's comment on data and collaboration, in that at one level "siloed" data may limit sharing and collaboration. An appraisal to a systems level thinking, where the focus turns to integrating cross disciplinary datasets, may see the setback disappear, giving way to competitive advantage. Many commentators talk about a "systems approach" but I suggest they don’t use this term correctly – which is the main reason why we consistently fail to implement at a systems level, nor gain the advantages that may be open to us. If we could realise cross disciplinary integration of datasets as a way to achieve a systems approach, we would certainly be on our way to discovering innovative alternatives that we never thought possible in the past, for certain kinds of hard problems.

We can’t compete on price with large providers such as Amazon Web Services (AWS). Instead, the services we need are in middleware and “interoperability”(i.e. a sophisticated integration of data/simulation models for creating large search spaces that enable systems analyses). Bear in mind that AWS and Microsoft Azure are constantly on the lookout for developer communities that can contribute to the development of middleware for their platforms, as the middleware is the applications gateway for realising competitive advantage in the marketplace. If we can develop this stuff, then we can capture partners and earn revenue from satisfied customers.

The good news is that we are seeing the same eco-system of standards and tools emerging for Hadoop that we saw emerge around the Linux OS last decade. This means we are getting some early maturity in the system abolishing the need to spend resources architecting everything from scratch anymore. I see no reason why we can’t have a small cloud capability here in NZ, but one that readily taps into the “big cloud” for access to the very powerful tools and advances overseas. We will be left behind if we remain focused on our little “computing centres”. We don’t want to reinvent the wheel when the Hadoop tools already exist. If we engage NeSI, then NeSI should provide a subsidiary cloud that allows us to link to bigger clouds where we can take advantage of a plethora of analytical libraries. Our two priorities need to be:

1. Tap into the Hadoop eco-system, and
2. Invest in middleware for data integration.

The strength for New Zealand from eResearch will be the ability to do analysis in real-time. To achieve this we need a high level of interoperability between systems and data. This is a forte for Living PlanIT, a software company fostering the development and implentation of Internet of Things. Brazil is currently investing

USD36bn with Living PlanIT (http://www.living-planit.com/pr_Convida_Alliance.htm) to develop "Smart Cities" technologies. Living PlanIT operates the "Urban OS™ or UOS™" – an operating system that aims to integrate the many technical systems that operate access to a major city. UOS™ can monitor millions of sensors and can control traffic lights and sprinkler systems, can call emergency services and evacuate buildings in an emergency. Developers and city planners can write their own apps for UOS™ that are "place-based apps". Living PlanIT is bringing together some of the world's greatest tech firms, such as IBM and McLaren Electronics. This same technology could create "smart farms" which would be of great benefit to NZ given that our economy is still dominated by primary industries. Emergency Response services could be informed; Civil Defence can be coordinated; the same UOS™ system with different tools can achieve "smart distributed operations" in many different fields or domains.

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This is a case of implementing a unifying system across all of the disparate models and data. Until we can demonstrate integrated systems and data, we can't model scenarios or understand policy implications at a regional or national level. This unifying approach goes right across the board, across all the National Science Challenges, or across patient stratification in the health system. Once the integrated data is accessible, you can start to innovate. IBM have suggested a framework or progressive way of developing a unifying system:

1. Instrument to Manage: install sensors networks;
2. Integrate to Innovate: integrated datasets offer opportunities to improve, and
3. Optimise to Transform: achieve more value in transforming or changing paradigms.

We talk about "big data" and we are slowly "sensorising" our world, but no one talks about interoperability. It is easy to see why, because making interoperability operational will require the break down of siloes and governance structural changes. Given that this is a daunting task that many are not willing to tackle, I worry that we will just end up with many different siloed systems that are not interoperable and therefore NZ businesses will fail to realise competitive advantage. If NeSI can assume the middleman between science and industry and offer guidance, tools and standards for interoperability across as many of our local, regional, and national investments as possible, then that would contribute a significant beneficial impact to both science and industry in New Zealand.

There is still no cohesive vision for eResearch in NZ. I find it quite frustrating that I sit in a room with people scratching their heads trying to figure out where best we could deploy high performance computing in support of the National Science Challenges, and yet to date no one has mentioned Smart Cities. That would be a significant National Science Challenge. Many of the big data, HPC-driven advances, are being fostered by "Smart Cities" developments, at both research and community grass-roots levels. For instance, The Covenant of Mayors in the EU is a deliberate coordinated cross-border initiative focused on Smart Cities technologies and polices. Living PlanIT is an example of applied innovation/research that is focused on Internet of Things and how it converges with urban environments and infrastructure, integrating disparate, large datasets for management and innovation of Smart Cities.

Water as a resource is also a National Science Challenge that could benefit from HPC and interoperability. For instance, up to 40% of clean water in some cities may be unaccounted for, for example through leaking infrastructure. To meet this challenge, we would need more than sensors, but also the practical and analytical tools to address the gap. With these problems and disparate datasets, we would also need the middleware to integrate the data and the simulation models. It is quite evident in NZ that there is no research funding for middleware development. Anyway, integration will remain key to discovering competitive advantage. I must stress that integration is not just about data access, analytical tools, and storage or archives, but more importantly governance structural changes and the breakdown of siloes, giving way to interoperability and middleware development for a systems approach. If NZ is to go down this path of Smart Cities, then we need NeSI to invest in a

National eResearch infrastructure that is positioned to support this capability.

Scientists and policy makers need to be made aware that "integration" is the means for taking advantage of big data. For example, Auckland's traffic is actually a serious national problem, but no one is proposing a big data, Smart Cities approach which would be critical in finding practical innovative alternatives to such a complex problem. If NeSI focused on Smart Cities, which is a horizontal endeavour, then industry would get on board and we would make a huge contribution to even manufacturing in Auckland and the economy in general. OC: HPC and big data have so much to offer to high tech manufacturing. The ability to simulate in detail and at a quantum level is already cutting the time to market for new and innovative materials (http://www.scientificamerican.com/article.cfm?id=how-supercomputers-will-yield-a-golden-age-of-materials-science).

Why is real-time important? Crisis response provides a typical example of one of the many areas it could be used, as does farming, which requires monitoring for daily management. The reason we fail in general to plan and manage for real-time problems is because of some of our conventional thinking paradigms. In many sciences "we kill the rat before we analyse it" – we want to stop the system before we "do science on it". Science needs to change because we can't stop the world to perform analyses. Weather is a great example of a constantly evolving phenomena. Social networks, commodity markets, etc are also great examples of constantly evolving systems. Science is too accustomed to stopping the system in order to study it, but those days are over. The days of producing equations/functions (a necessity when you have minimal data) to describe a phenomena are numbered, because now we've got data! In science and engineering, we model the real world because we want to control/manage systems. In the new world we have data – real-time big data, and so it is imperative we invest heavily in learning new skills to "mine" and optimise for information acquisition.

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