SMART Agent Based Modelling (ABM) Capability Statement

The University of Wollongong is building a $61.8 million world-class research, training and simulation centre to address Australia’s future infrastructure needs. The SMART (Simulation, Modelling and Analysis for Research and Teaching) Infrastructure Facility draws together the University’s expertise in Engineering, Science, Commerce and Information Technologies.

Central to the new facility’s capabilities will be a Simulation Centre which models and simulates the complex interdependencies of interconnected infrastructures. This will extend the University’s existing capability to model engineering, materials, social and economic aspects of infrastructure being researched in other laboratories within the University.

One method of demonstrating these complex interdependencies is by the use of Agent Based Modelling (ABM). ABM is a powerful multi-disciplinary analytical approach that can investigate integrated infrastructure solutions. It can enable, for example, transport planners to better understand land use, infrastructure, population density and mix, cultural factors, accessibility and congestion and how these parameters may affect community’s transport modal choice.

ABM’s represent individual agents, their behaviours, natural decision making and interactions. It is much more fine-grained than mathematical models and can build in learning & communication. For instance agents can learn what the most effective transportation options are and pass on this information to other agents.

An ABM can capture emergent behaviour – it models and simulates the behaviour of the system’s constituent units (the agents) and their interactions, capturing emergence from the bottom up when the simulation is run. Individual agent behaviour may exhibit memory, path dependence, learning and adaptation.

ABM’S provide a unique opportunity to engage stakeholders by demonstrating ‘what if’ scenarios. Using models as part of a process of ascertaining possible futures can assist in decision-making and showcase how new emergent behaviour may impact on a community.

ABM provides a natural description of a flexible system. It allows the separation of the “what” from the “how”, rules can change with time, policy, situation awareness. Level of granularity of agents can be adjusted as greater understanding develops, with different levels co-existing in a single model.

Recent business examples of the use of Agent Based Modelling:

- Australian Energy Markets - Energy pricing strategies of producers and resellers, and implications for new contestants
- Telecommunications - Internet usage patterns for planning of broadband infrastructure
- Logistics – Global shipping implications for timely delivery of goods and land-side port infrastructure requirements
- Land Use Planning - Examine the relationship between land use and infrastructure, and impact of congestion for take up of public transport
- Public Transport - Spatial analysis of dwellings with respect to public transport routes and hubs
- Pandemic modelling – forecasting the spread of contagions ie swine flu, through a community

How can SMART assist industry?

- By undertaking modelling/simulation work
- Managing strategic analysis/modelling work
- Reviewing modelling/simulation work done by external groups
- Developing customised scheduling/planning tools
- Providing a software environment allowing clients to ask 'What-if' questions and to quantify benefits, drawbacks and cost-effectiveness of different designs, infrastructure expenditures, operating and scheduling regimes, etc.
- Providing visualisation of results of simulations (eg showing queues developing in 'real-time') and, more importantly, quantitative measures of cost-effectiveness.

SMART expertise in the development of Agent Based Models to suit the needs of industry will demonstrate how a model can be viewed and interpreted by non-specialist social and political decision makers. This methodology will provide non specialists with a reliable user friendly and interactive visual appreciation of a model and also present the impacts on any stakeholders they may wish to identify.

The SMART Infrastructure Facility looks forward to assisting industry in developing integrated solutions to complex problems.

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