



ABOUT CAST

Cities of the future are in fact cities of today, but 50 or more years later. If not properly handled, inherent problems of individual cities of today are likely to create even greater problems in the future.

As cities are incredibly complex, planning without tools that can tackle the Complexity is not likely to produce sustainable results. For instance, even a system consisting of 20 components which interact with each other in 10 different ways has a hyper-astronomic number of possibilities of 10^{20} . A city has far more components, interacting with each other in many more different ways. This incredibly large number of possibilities cannot be successfully explored manually or by using conventional tools. Conventional planning of cities will therefore leave many aspects of the city open ended, possibly causing the city to develop in an undesirable way.

However, careful planning of various aspects of the development of the city is likely to produce a more sustainable development and a more efficient city of the future. A City Analysis Simulation Tool – CAST has therefore been developed to help improve the quality of urban life in the future.

Scientific approach

CAST has been developed on the basis of principles of Complexity. The structure of CAST is based upon cells that represent the built environment, the land use type, in other words the function of the cell. Unlike the natural world, structures (and non-build space) in the human environment are a product of human purposes. In addition flowing through the cells, driving their changes, are humans and their actions, their metabolism.

CAST uses economic principles of self-regulating markets, where the price and consumer behaviour

stimulates the self-regulation. The cells are placed on a rectangular grid, where they interact with other cells on the basis of connections between them established through the market mechanisms and on the basis of processes inside them. This method is based on Cellular Automata, with various extensions to allow long range connectivity as found in cities.

The connections between the cells effectively form networks between the cells on the basis of characteristics of each cell. For instance, through the operation of four market mechanisms (product, service, employment, and property markets), a residential cell will connect to an employment cell to get work and income, and to retail and service cells to purchase food and other goods, and obtain a range of services, including utilities, education, and others. Thus, the market mechanisms will stimulate the creation of networks and links are formed only if transaction costs are acceptable (the equi-marginal principle).

Consequently, a complex model of the city emerges from the network based interaction of city components governed by simple rules on a component level, and without explicit programming of the city model as a whole.

Results and benefits

As result of simultaneous operation of various processes in CAST, the following emergent behaviour will occur in the model:

- Population – Demographic changes and its implications
- Economics – Results from connectivity between cells and operation of market mechanisms
- Land use - Changing patterns of land use are a consequence of collective interaction of all mechanisms in the model
- Transport - demand for transport is an emergent property resulting from the network connectivity

CAST therefore enables investigation of highly non-linear future consequences resulting from simple changes in individual parts of the city

today. CAST is therefore be unlike any other city simulation tool known today, from which the users can learn something new about future development of their cities.

Expected impacts

CAST enables the end user to simulate scenarios of changes over a number of years, showing what the city would be like in the future. Simulations of 10 to 15 years of real-time are compressed in the computer model to the timescale of minutes. \

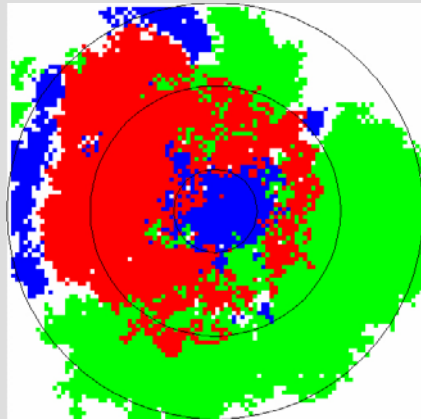
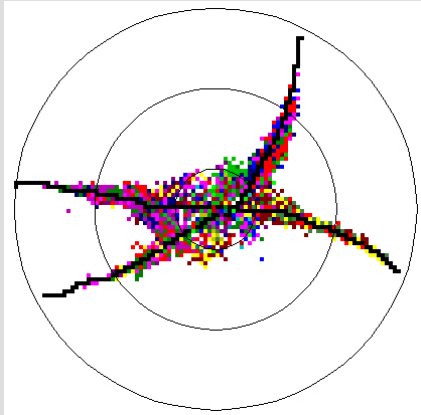
CAST simulation shows complex interactions between future developments and the existing urban environment. The user is able to insert new developments into the city and investigate their impact through simulation.

Simulation results obtained from CAST inform decision-makers, planners and the public about options and impacts, so aiding better informed policy to increase sustainable development and improve the quality of urban life in the future

Is CAST yet another SIMCITY?

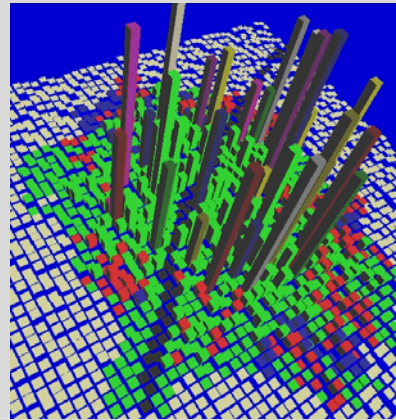
There is a fundamental difference between SimCity and CAST. In SimCity, the user controls everything. As the model is top-down, there is no room for the model to self-develop through complex interactions and connectivity between components. SimCity therefore cannot simulate the complexity of the city.

The CAST approach is based on principles of Complexity and models cities as truly complex systems, emerging from the bottom-up, as result self-organising and self-developing. Links between city components are created dynamically, through market mechanisms, forming a complex network of processes and transactions analogous to the real city. As this complex network evolves, the results of CAST simulation can tell something new to the user, far beyond the knowledge of the creators or users of the software.



CAST model, showing road following as emergent property of land use development (top) and two-dimensional land use simulation (bottom).

economics, land use, transport and population dynamics. Operation of the model has been tested using data from several local authorities. CAST allows the rapid exploration of many 'what-if' scenarios including the impact of possible development and policy changes.



CAST model with interactive three-dimensional fitness diagram

CAST has been developed in collaboration between researchers, urban practitioners and computer scientists. The underlying principles of CAST are designed to capture the complexity of cities through a component based approach driven by an extended Cellular Automata model structure. The system model obtained through the interaction of components addresses the key aspects of the complexity of cities by integrating

Download site: www.intesys.co.uk/cast/

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CAST

City Analysis Simulation Tool

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Process and Software Tools for Analysis and
Simulation of Development of Cities into the Future



CITY ANALYSIS SIMULATION TOOL