

# Modelling Individual Consumer Behaviour

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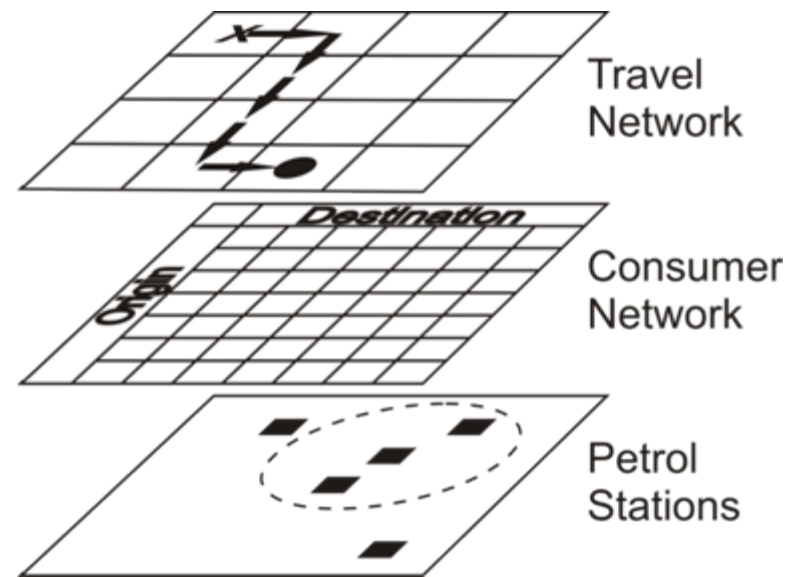
- Overview project
- Motivation for project, aims, proposed framework
- Modelling human behaviour
  - Behavioural frameworks
  - Example: ABM of Crime
- Conclusions

- Motivation: Retail models: mature but limited
  - aggregate populations
  - limited shopping behaviours (internet, multi-purpose)
  - increased data and computational power
- Recent work: ABM of retail market (demand side)

Heppenstall, et. al  
(2005, 2006, 2007)

But:

- consumers still aggregated
- transport network simplistic



# Modelling Individual Consumer Behaviour (MICB)



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- ESRC First Time Grant: Oct 2008 – Oct 2010

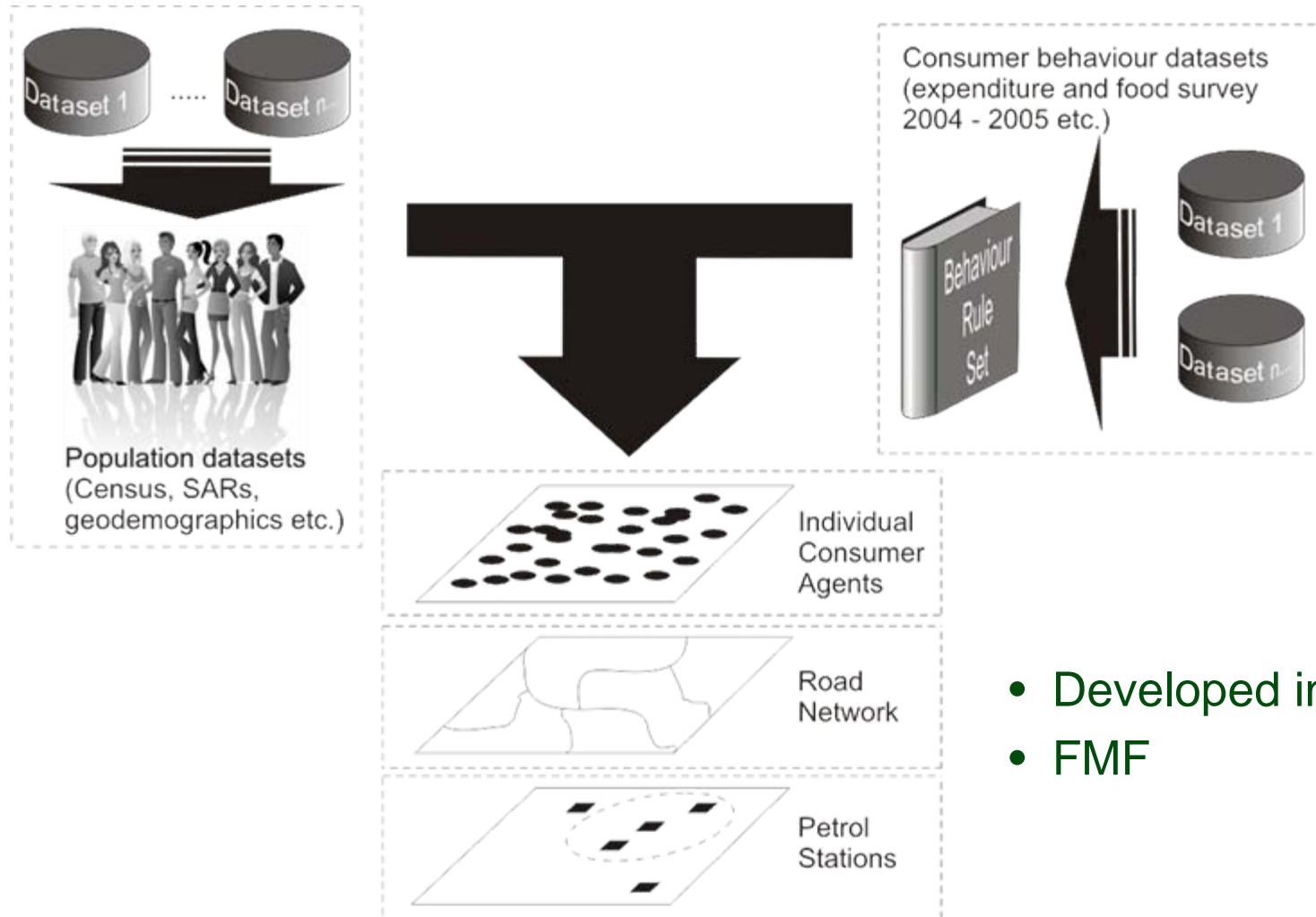
## Aims:

- Create population of individual consumer agents
  - Addition of realistic consumer behaviour
  - Implement real transport networks
  - Application to test cases e.g. supermarkets, education, post offices
- 
- Dr Kirk Harland

# Proposed Framework



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- Developed in Java
- FMF

# Consumer Behaviour: Data Sources



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<b>Year</b>	<i>Description</i>	<i>Consumer Behaviour</i>
National Travel Data Survey, 2002 – 2004	Car ownership; journeys made by household.	Personal and household travel behaviour.
Family Expenditure Survey 2000 – 2001.	Sample information on household expenditure.	Spending and consumption patterns.
Expenditure and Food Survey 2004-2005	Details on sample household expenditure on types of food.	Food consumption and purchasing behaviour.
Retail Consumption and Consumer Choice, 2002 – 2004.	Impact on consumer of the increase of supermarkets and decline of corner shops.	Individual food diaries and purchasing behaviour.
General Household Survey	Information on household consumer durables.	Spending and consumption patterns.
British Household Panel Survey	Interviews with representative sample of individuals at household level.	Spending and consumption patterns.
Food Deserts in British Cities, 2000-2001	Food diaries; household questionnaires.	Shopping habits of 600 consumers in an urban area.
Axciom	Large survey of consumers	Multiple variables including income



- Important and unpredictable element of modelling.
- Increasing interest in how to incorporate into ABM.
- Four approaches identified by Pah-Wostl & Ebenhoh (2004)
  - Established formalised theoretical network
  - Borrow concepts and build a simulation model
  - Start with a simple rule set and build up
  - Observe individuals and extract regularities of behaviour
- Consumer behaviour = react to need, sales, convenience...

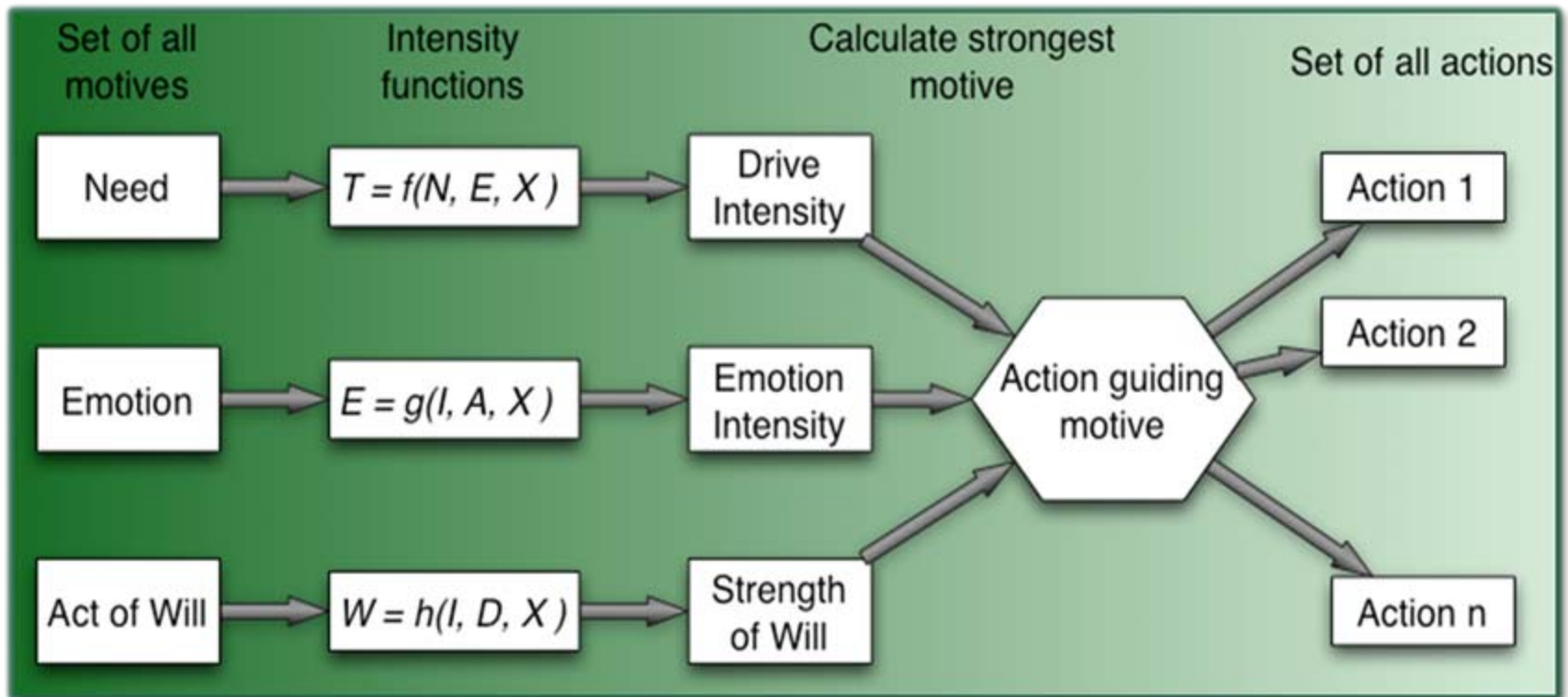


## **Beliefs Desires Intentions (BDI)**

- Practical reasoning: decide what the goals are and how to achieve them
- **Beliefs**: knowledge about the world
- **Desires**: all goals the agent is trying to achieve
- **Intentions**: most important goals

## **PECS** (Schmidt, 2000; Urban, 2000)

- **Physical Condition**
- **Emotional States**
- **Cognitive Capabilities**
- **Social Status**





## Needs

- “lifestyle”, sleep, drugs

## Cognitive map of environment

## Burglary:

1. Decide to commit a burglary

2. Find suitable target

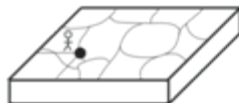
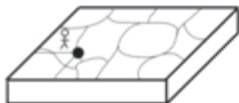
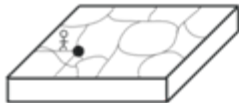
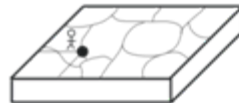
1. Visit known good target, or
2. See opportunity on route without specifically looking, or
3. Search for a target

3. Burgle

- Two components
  - Virtual environment
  - Burglar agents
- Environment simulate presence of virtual victims (houses) and guardians (passers-by)

## Environment layers

### Community



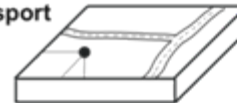
1. Collective Efficacy
  - a. Voter Turnout
  - b. Concentrated Disadvantage
  - c. Residential Stability
  - d. Ethnic Heterogeneity

2. Relative Attractiveness

4. Traffic Volume

5. Occupancy

### Transport



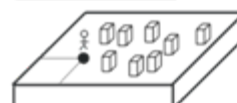
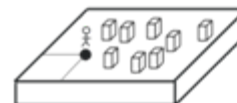
Roads (foot, car)

Bus routes (bus)

Train routes (train)

Alleyways (foot)

### Individual Properties



1. Accessibility
  - a. Number of Possible Entrances

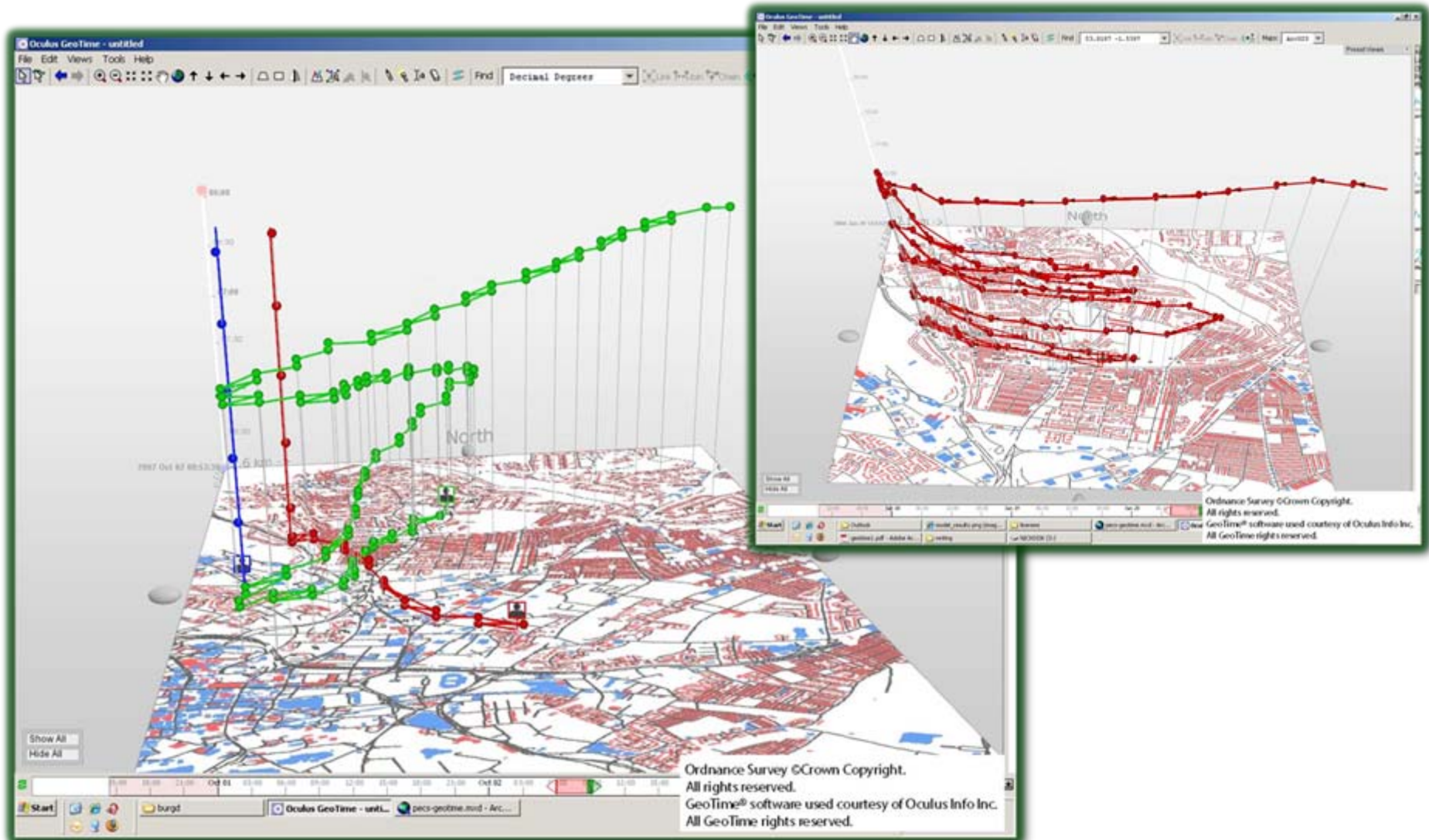
2. Visibility
  - a. Size of Garden
  - b. Degree of Isolation
  - c. Set back from road

3. Security
  - a. Specific security features of property

# Results – Analysing Agent Behaviour



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- MICB: grant to explore and implement an ABM for modelling individual consumer and their behaviour.
- However, no established ways for incorporating human behaviour into ABM.
- Investigate learning algorithms – give agents memory?
- Malleson: PECS model implemented
- BUT
  - Use of network layers makes city sluggish to run
  - Require better communication between agents – social network?
- Open to suggestions about approach to take...

# Acknowledgements/References



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