

### Defining the Objectives

- Aim**
  - Study normative comparison in an office environment
- Objectives**
  - Answer the following questions:
    - What are the effects of having the community influencing the individual?
    - What is the extent of impact (significant or not)?
    - Can we optimise it using certain interventions?
- Hypotheses**
  - Peer pressure leads to greener behaviour
  - Peer pressure has a positive effect on energy saving
- Experimental factors**
  - Initial population composition (categorised by greenness of behaviour)
  - Level of peer pressure ("individual apportionment" vs. "group apportionment")
- Responses**
  - Actual population composition (capturing changes in greenness of behaviour)
  - Energy consumption (of individuals and at average)

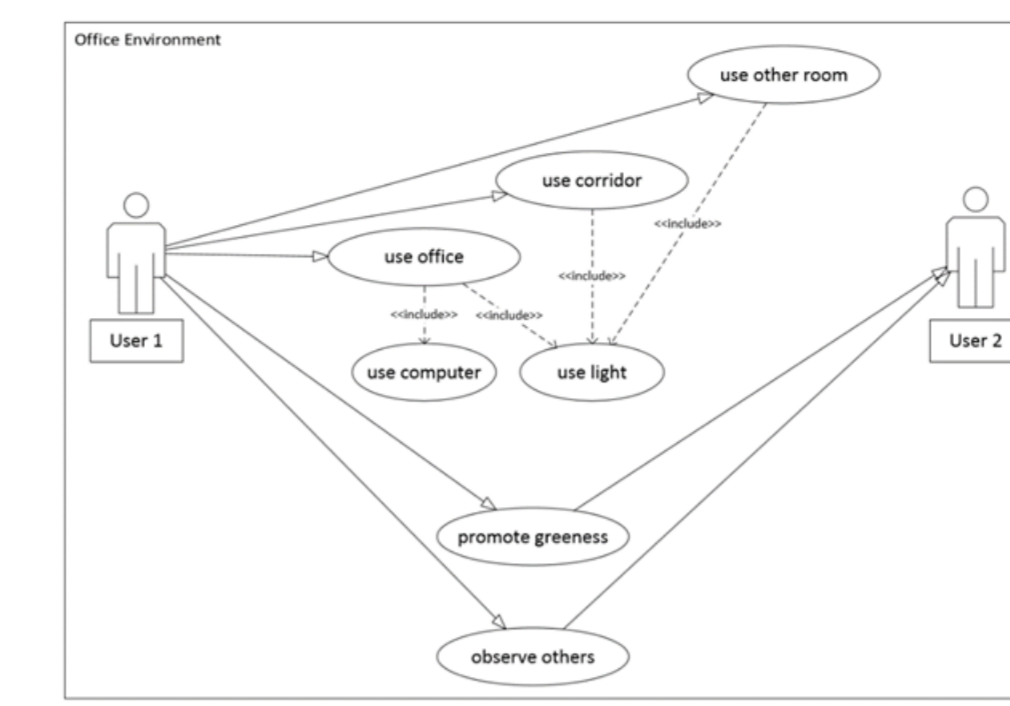
### Defining the Scope

- Scope**
  - After some discussions within the focus group we decided that "transparency" would be the key driver for our decision making and that we want to abstract/simplify as much as possible while still keeping a realistic model
  - In order to have easy access to data we decided to use our own offices as the data source

Category	Element	Decision	Justification
Actor	Staff	Include as group (User)	Regularly occupy the office building
	Research fellows	Exclude	Insufficient energy use
	PHD students	Exclude	Do not have control over their work environment
	UG-MSc students	Exclude	Do not have control over their work environment
Physical Environment	Visitors	Exclude	Insufficient energy use
	HVAC (Heating + Ventilation + Aircon) system	Exclude	We only need one major energy consumer to test the theory; we decided to go for electricity
	Lighting	Include	Interacts with users on a daily basis; controlled by user
	Computer	Include	Interacts with users on a daily basis; controlled by user
	Monitor	Exclude	Modelled as part of the computer
	Continuously running appliances	Exclude	Constant consumption of electricity; not controllable by individuals
	Personal appliances	Exclude	No way to measure consumption
	Temperature	Exclude	Not necessary for proof-of-principle
	Natural light level	Exclude	Not necessary for proof-of-principle
	Office	Include	Location where electronic appliances are installed
Room	Lab	Exclude	Mainly used by UG/MSc
	Kitchen	Include as group (Other Room)	Common areas frequently used by "users"
	Toilet	Exclude	Common areas frequently used by "users"
	Corridor	Include	Commonly used when "users" move around
Social / Psychological Aspect	Comparative feedback	Include	Effective strategy to reduce energy consumption in residential building
	Informative feedback	Include	Effective strategy to remove barriers in performing specific behaviour
	Apportionment level	Include	Potential strategy to reduce energy consumption in office building
	Freeriding	Include	Behaviour that differentiate two apportionment strategy
	Sanction	Include	Factor to encounter freeriding behaviour
Anonymity	Include	Factor to encounter freeriding behaviour	

### Defining Key Activities

- System boundaries**
  - Building boundaries of the office environment



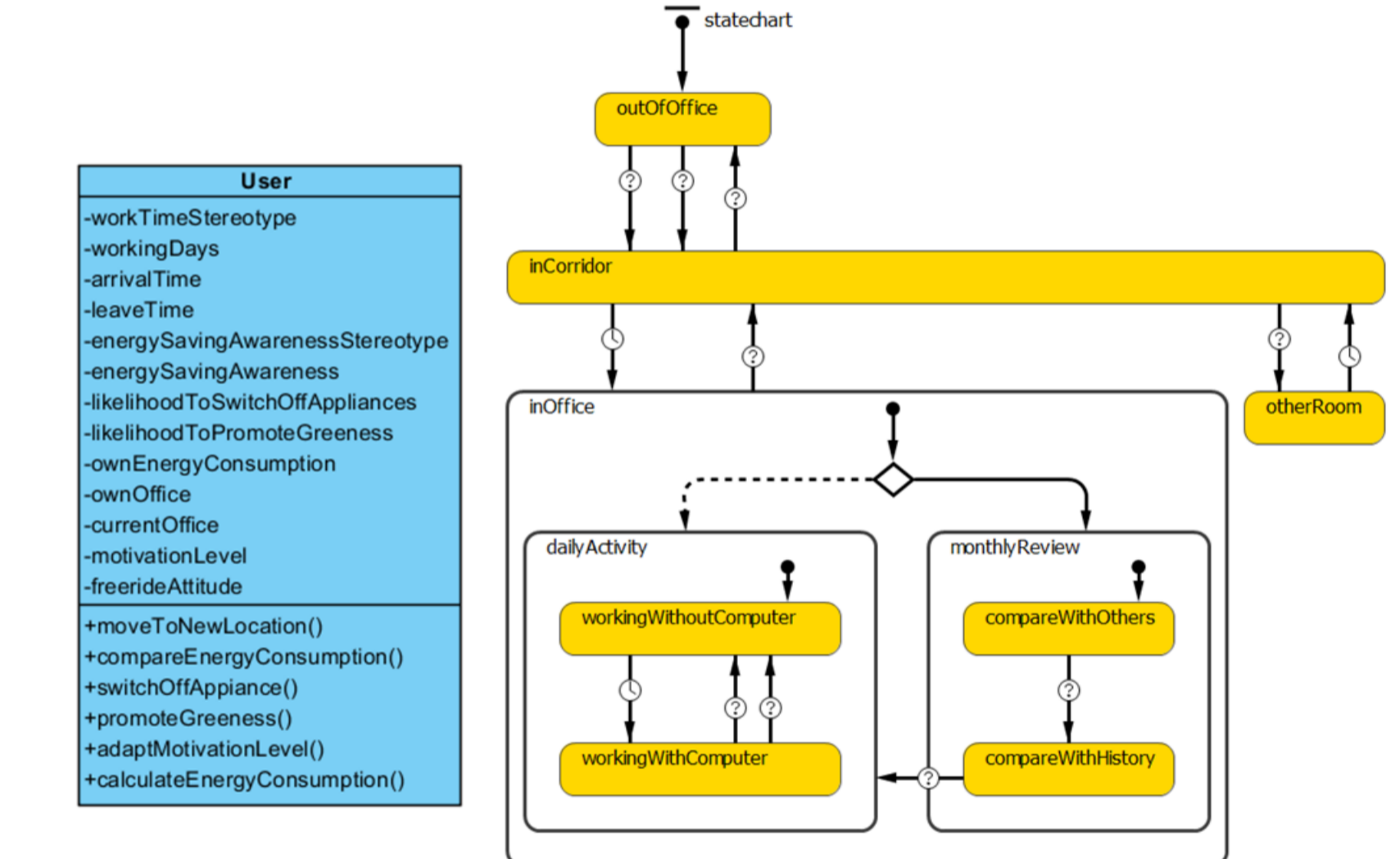
### Defining Stereotypes

- We identified two categories of stereotypes
  - Habits for work time
    - Arrival time at office
    - Leaving time from office
  - Habits for Energy Saving Awareness
    - Energy saving awareness
    - Likelihood of switching off unused electric appliances
    - Likelihood of promoting greenness
- A survey was conducted asking our research group members

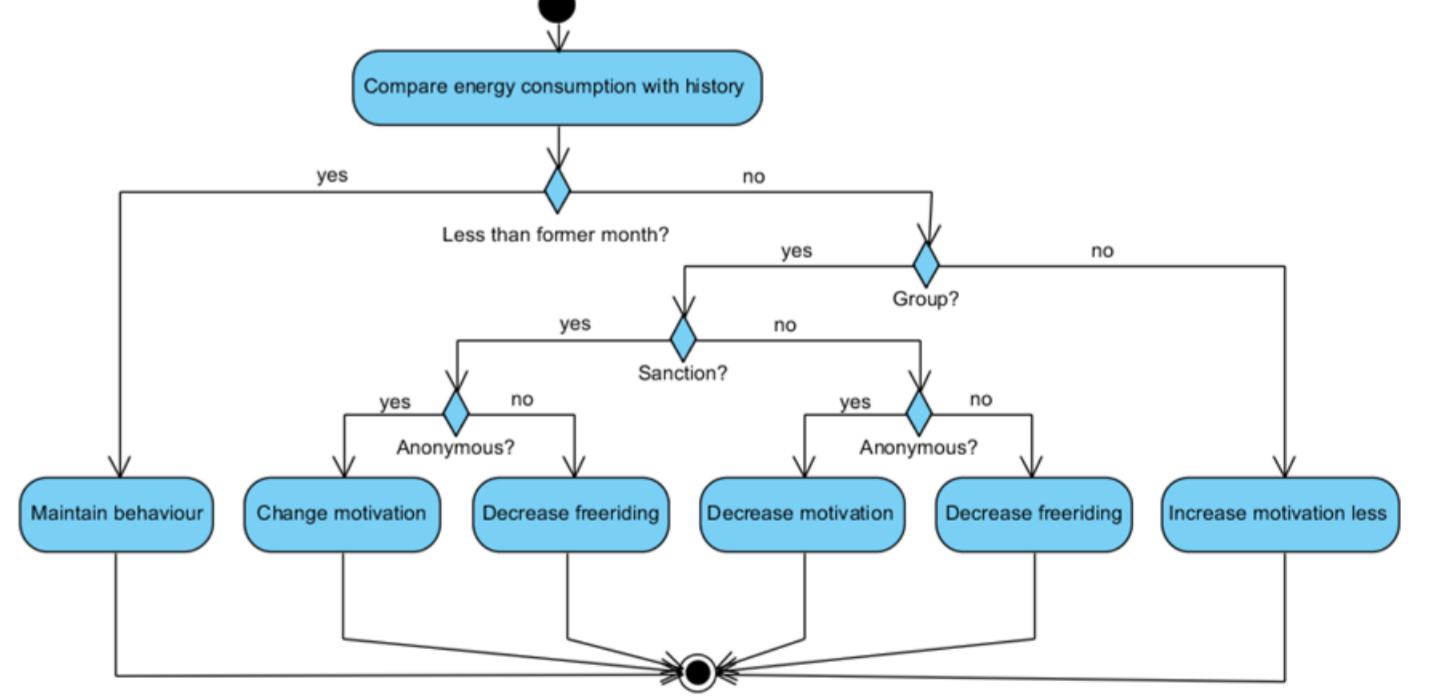
Stereotype	Working days	Arrival time	Leave time
Early bird	Mon-Fri	8am-9am	4pm-7pm
Time table compiler	Mon-Fri	9am-10am	5pm-6pm
Flexible worker	Mon-Fri	10am-1pm	5pm-11pm
Hardcore worker	Mon-Fri + Sat	8am-10am	5pm-11pm

Stereotype	Energy saving awareness (0-100)	Probability of switching off unnecessary appliances	Probability of sending emails about energy issues to others
Environmental champion	95-100	0.95	0.9
Energy saver	70-94	0.7	0.6
Regular user	30-69	0.4	0.2
Big user	0-29	0.2	0.05

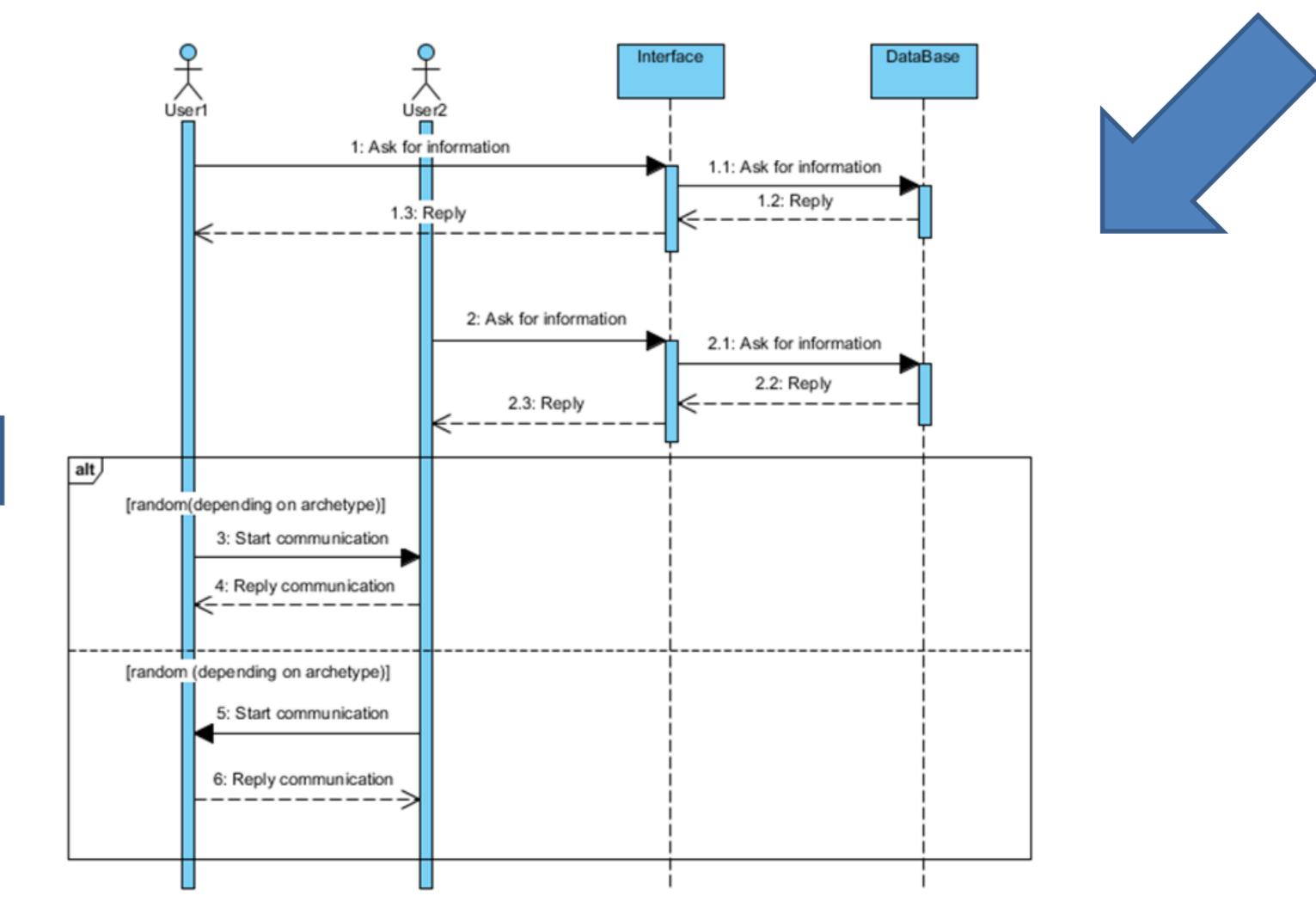
### Defining Agent and Object Templates



From state	To state	Triggered by	When?
outOffice	inCorridor	Condition	At typical arrival time during the working week for all
outOffice	inCorridor	Condition	At typical arrival time on Saturdays for hard-core workers only
inCorridor	outOffice	Condition	At typical leave time
inCorridor	inOffice	Timeout	At average after 5 minutes
inOffice	inCorridor	Condition	At random while at work or when leaving
inCorridor	otherRoom	Condition	At random while at work
otherRoom	inCorridor	Timeout	At average after 10 minutes



### Defining Interactions



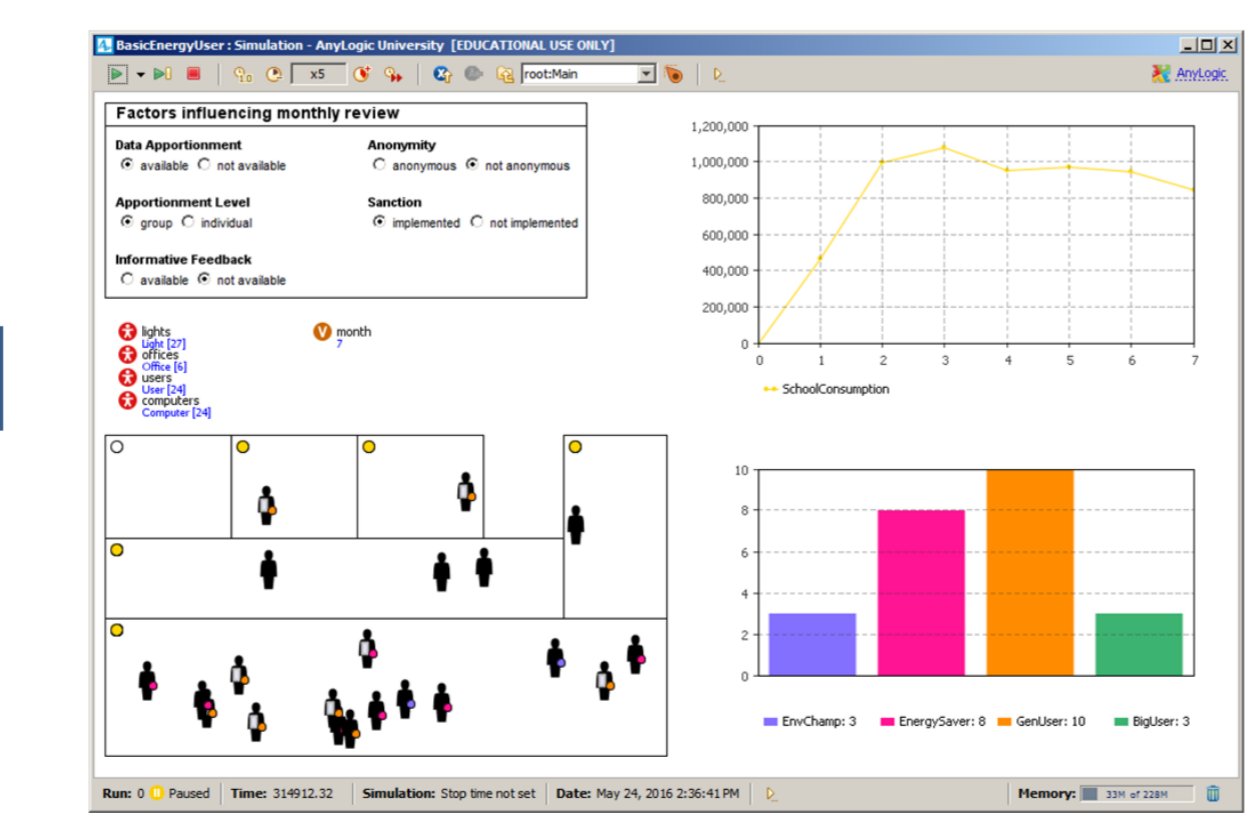
### Defining the Artificial Lab

- We need to consider things like:
  - Global variables
    - e.g. to collect statistics
  - Compound variables
    - e.g. to store a collection of agents and objects
  - Global functions
    - e.g. to read/write to a file

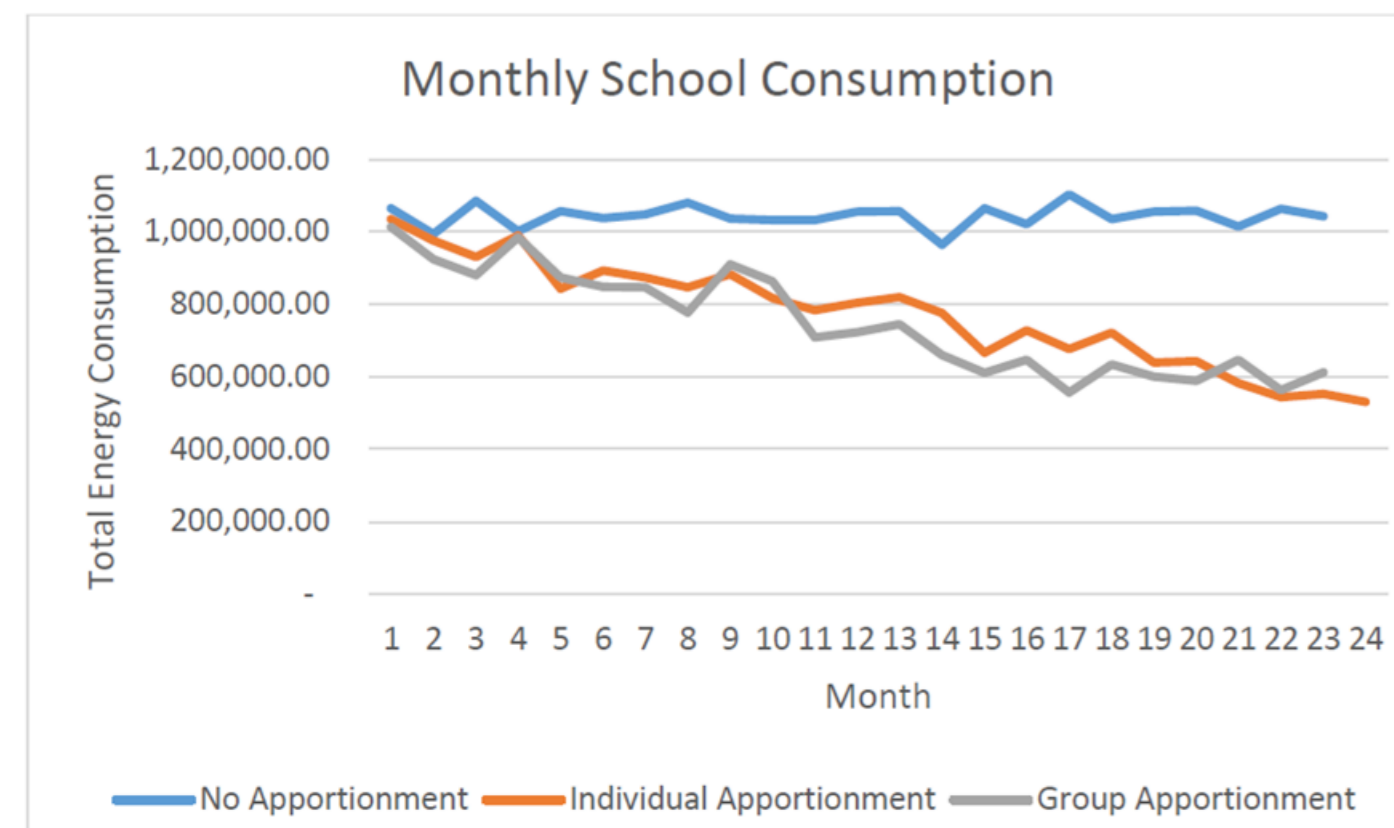
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Artificial Lab
-#SchoolEnergyConsumption
-#numEnvironmentalChampions
-#numEnergySavers
-#numGeneralUsers
-#numBigUsers
-#DataApportionmentAvailable
-#ApportionmentLevelGroup
-#InformativeFeedbackAvailable
-#AnonymityGiven
-#SanctionImplemented
-#users[]
-#office[]
-#lights[]
-#computers[]
+calculateSchoolConsumption()
+writeDataToFile()
+findOffice()
  
```

### Implementing the Model



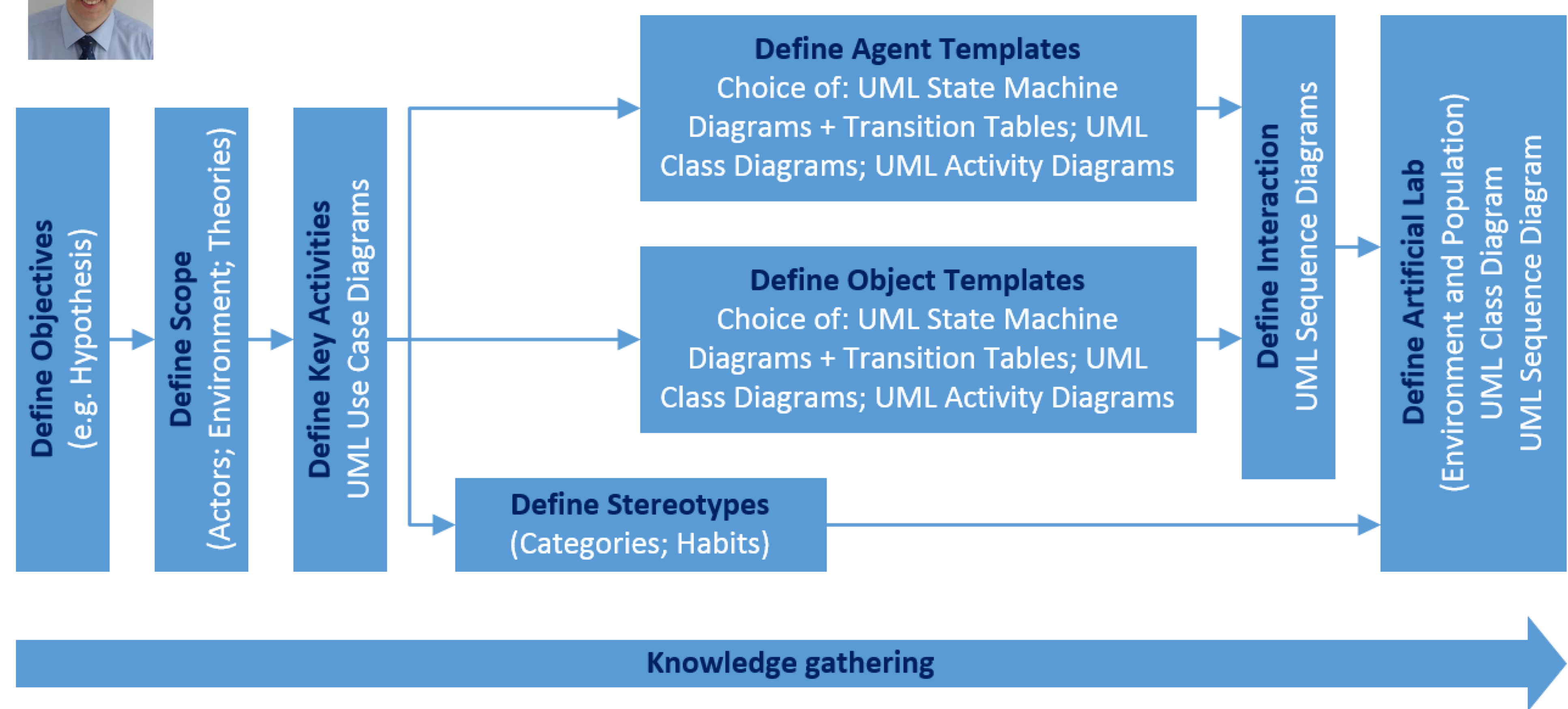
### Experimentation



## Facilitating Multidisciplinary Agent-Based Social Simulation Modelling A (More) Formal Approach

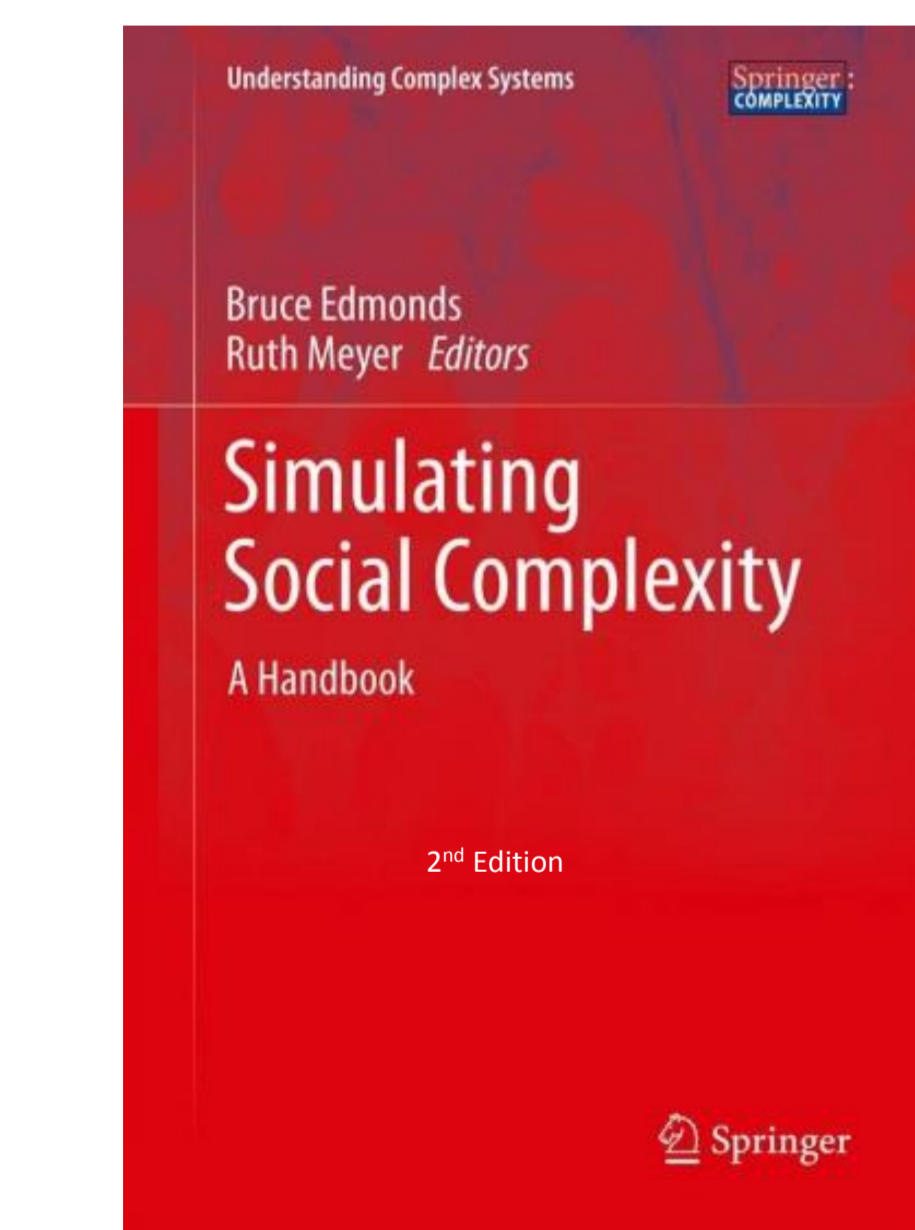


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When aiming to develop Agent-Based Social Simulation (ABSS) models one faces the question of how to build them and where to start. This can be challenging not only for novices in the field but also for multidisciplinary teams where it is often difficult to engage everyone in the modelling process. In this case co-creation is an important aspect. Team members need to be open minded about the use of new tools and methods and about the collaboration with researchers from other domains and business partners. Over the years we have developed a quite sophisticated "plan of attack" in form of a framework that guides the model development and can be used by either individuals or teams.

The framework supports model reproducibility through rigorous documentation of the conceptual ideas, underlying assumptions and the actual model content. It provides a step-by-step guide to conceptualising and designing ABSS models with the support of Software Engineering tools and techniques. While this framework will not work perfectly for all possible cases, it provides at least some form of systematic approach. The user should be prepared to adapt it to fit individual needs.



For more information see: Siebers PO and Klügl F (in press) 'What Software Engineering has to offer to Agent-Based Social Simulation'. In: Edmonds B and Meyer R (Eds). Simulating Social Complexity: A Handbook - 2e

### Knowledge Gathering

- Focus groups:**
  - Facilitator from
    - Computer Science
  - Participants consisted of a mixture of academics and researchers from
    - Computer Science
    - Business Management
    - Psychology
  - We did not engage with business partners
  - Five core members that would participate regularly in the focus groups

### Case Study

- Studying the impact of normative comparison amongst colleagues with regards to energy consumption in an office environment

