EABSS Workshop 2023

Co-Creation of Agent-Based Social Simulation Models

Engineering Agent-Based Social Simulations

Introduction

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

What is this all about?

- Social Simulation (formal definition)
  - Studies **socio-economic phenomena** by investigating the social macrostructures and **observable regularities** generated by the behaviour and relationships between individual **social agents**, and between agents and **the environment** in which they act.

- Agent-Based Social Simulation (ABSS)
  - Example from the Gaming World
    - SIMS4: Promotion Video (https://www.youtube.com/watch?v=dcDy1CCd-F8)
    - SIMS4: Hands-On Gameplay (https://www.youtube.com/watch?v=pXLEAHpzFks)

Engineering ABSS

- Agent-Based Modelling:
  - A complex system is represented by a **collection of agents** that are programmed to **follow some behaviour rules** and the **system properties emerge** from its constituent agent interactions

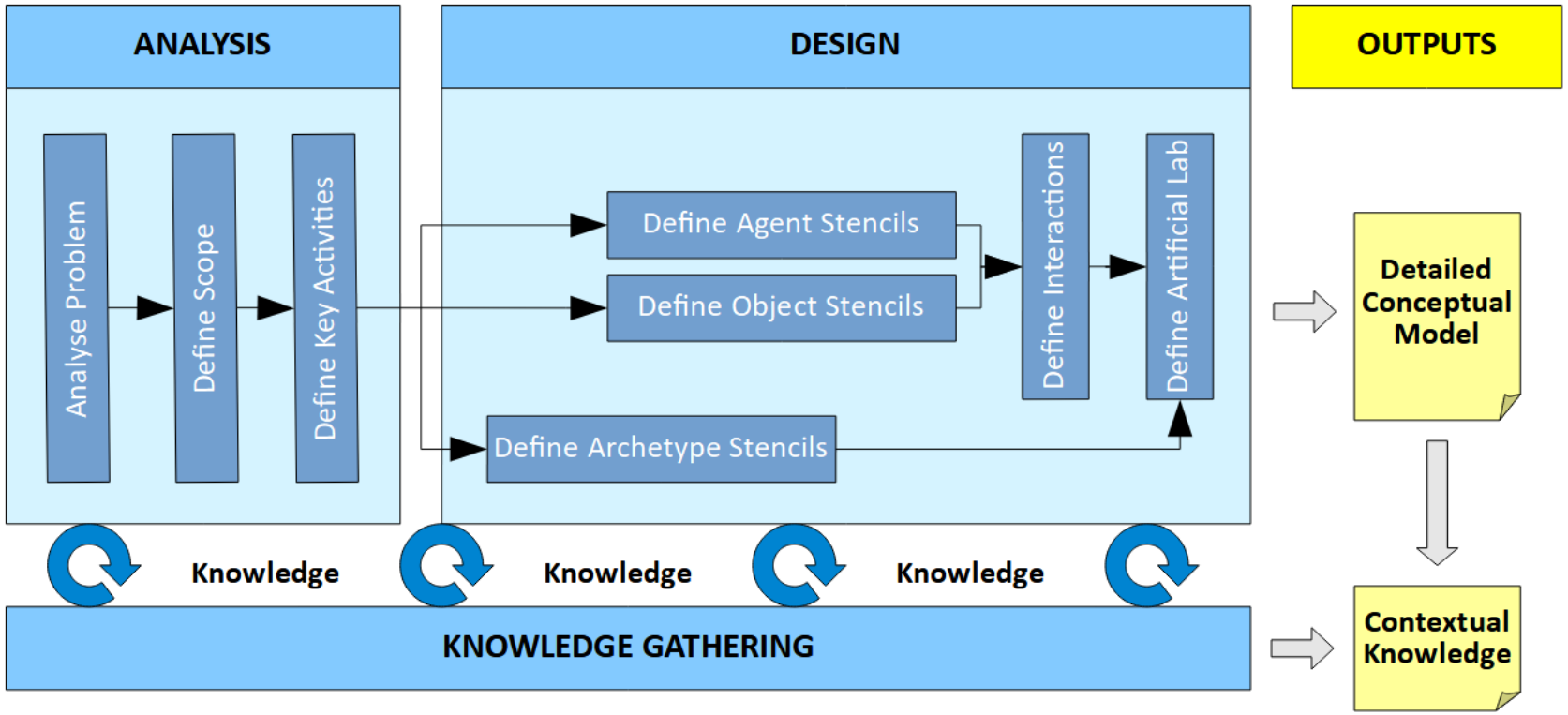
- How do we develop such Agent-Based Models (ABMs)?
  - It would be good to have **a structured approach** ...
    - ... to support multi disciplinary collaboration
    - ... to work with all kinds of stakeholders (academics / non academics)
    - ... for exploratory and explanatory studies
    - ... for communication; conceptual modelling; reverse engineering

Engineering ABSS

- What do we mean by "agents"?
  - Agents are "**objects with attitude**" (Bradshaw 1997)
  - Similar to non-player characters in computer games
- Properties (borrowing from AI):
  - Discrete entities
    - Have a memory
    - Have their own goals (missions)
    - Have their own thread of control
  - Autonomous decisions
    - Capable to adapt and to modify their behaviour
  - Proactive behaviour
    - Actions depending on motivations generated from their internal state

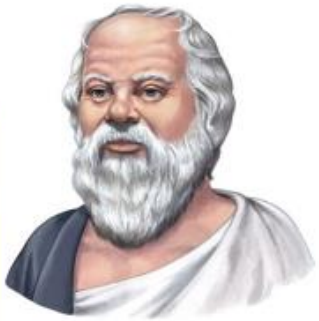
The EABSS Framework

- A structured approach ...



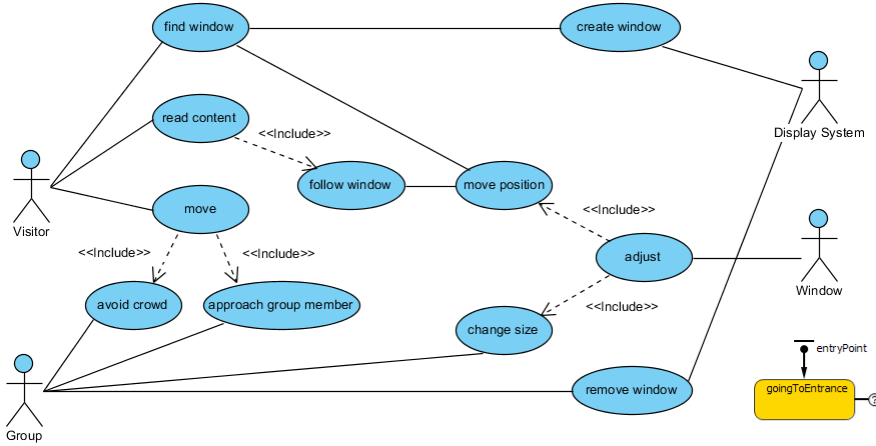
The EABSS Framework

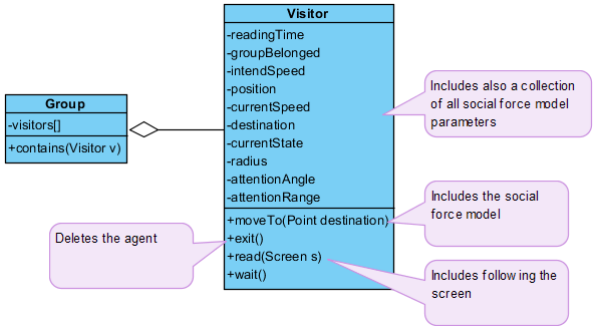
- … using mini focus groups …
  - Group sizes of **4-5 participants** (including moderator) work best
  - Estimated time to get through the whole process: **8h** (but there is a shorter version of **2h**)
  - Socrates vs Confucius
    - Collaborative brainstorming
    - Information capturing
    - Debates only when needed
  - Moderators
    - Will guide
    - Will act as stakeholder (modeller)
  - Iterative process
    - Reuse of information
    - Important to go forward and backwards

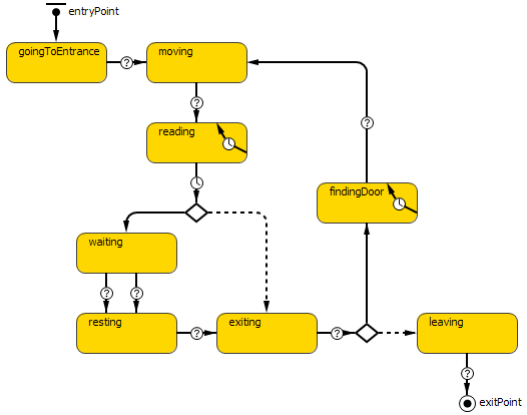


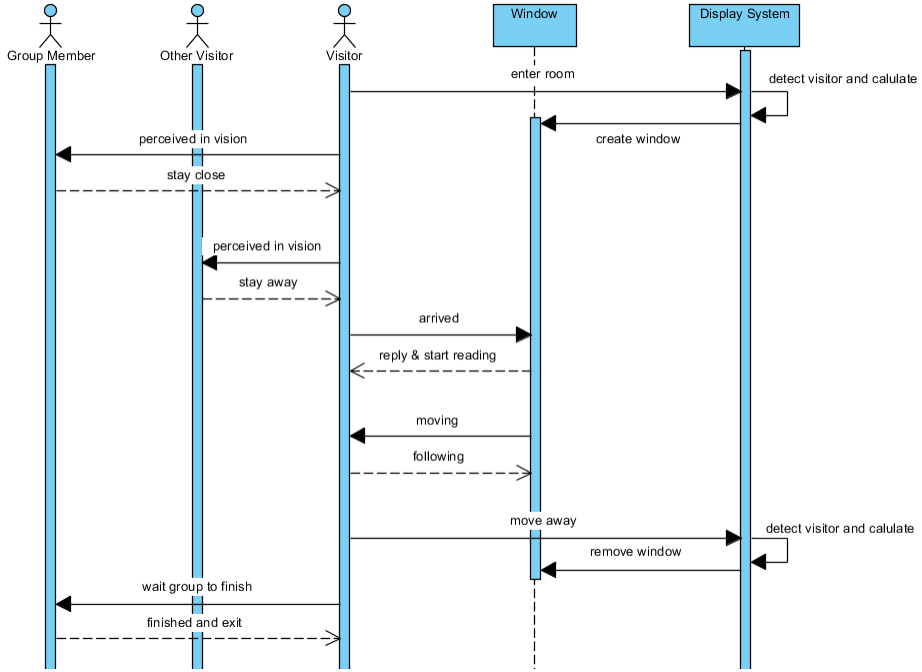
The EABSS Framework

- … and a graphical notation commonly used in Software Engineering









The EABSS Framework

- 8 hour version
  - Briefing (Introduction + Example)
  - Analysis
  - Design
  - Debriefing
- 2 hour version (analysis is done a-priory)
  - Briefing (Introduction + Example + Analysis)
  - Design
  - Debriefing
- Usually good to have a note taker or to moderate in pairs
- Make sure participants understand why they are doing the exercise

The EABSS Framework

- The EABSS framework can be used for two different purposes
  - For collaborative model development (from scratch or to extend/validate existing models)
  - To stimulate and formally support discussions about philosophical questions of societal issues that need to be addressed

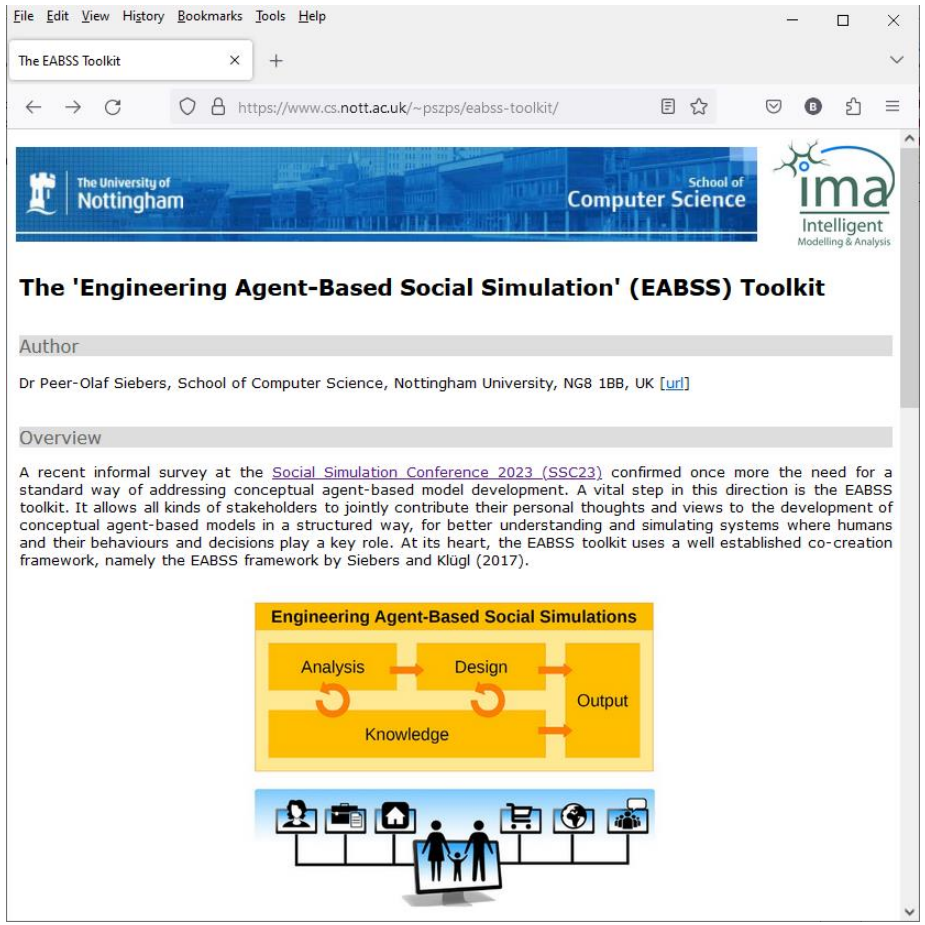
- We have tested the EABSS framework in several domains
  - Architecture
  - Geography
  - Organisational Behavior (Siebers et al 2020)
  - Digital Mental Healthcare (Vallejos et al 2019; Siebert et al 2020; Barnes and Siebers 2020)

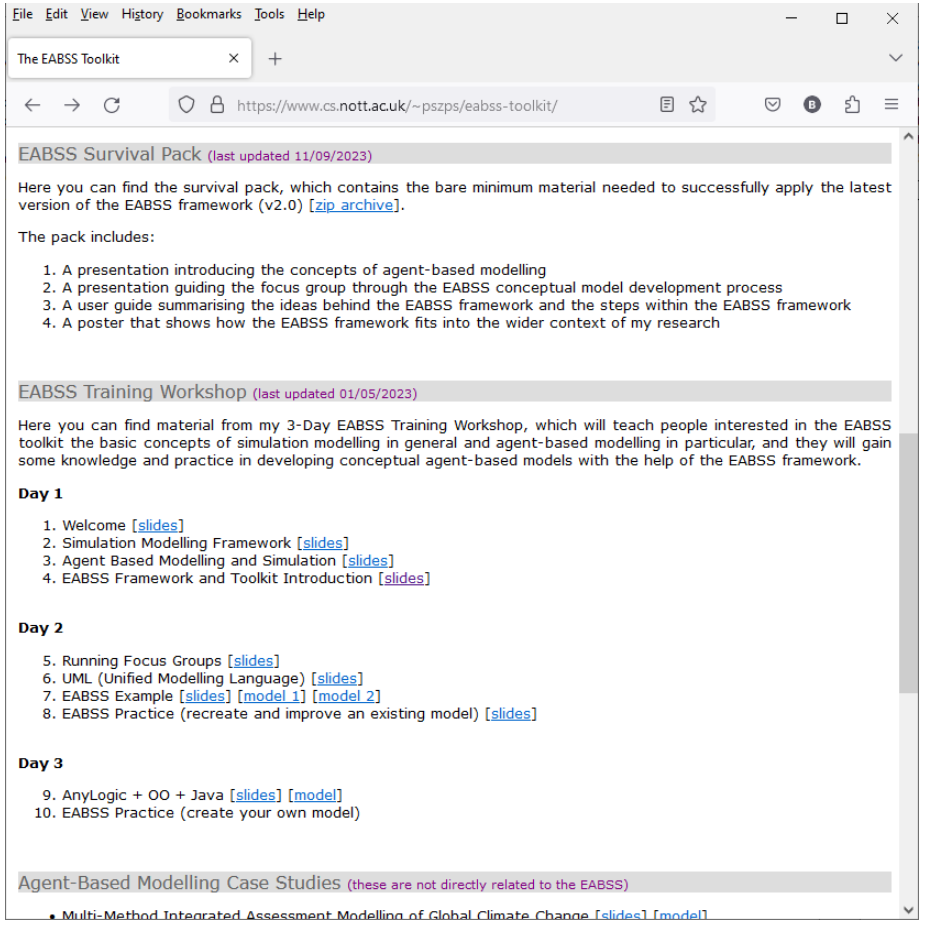
The EABSS Toolkit

- Online collection of artefacts to train and support the EABSS moderator
  - EABSS survival pack
  - EABSS workshop material (slides, example, resources)
  - Guidance on alternative EABSS project workflows

The EABSS Toolkit

Web Presence





The EABSS Toolkit

Project Workflow

- Preparation
  - If starting from scratch: Define broad theme
  - If not starting from scratch: Conduct relevant Analysis steps
- Round 1
  - Main process for conceptual model development or discussion; delivers a full-fledged conceptual model leading to a complex implementation
- Round 2
  - Validation and filling the gaps
- Prototype
  - Create (or reduce developed conceptual model into) a prototype, following the KISS principle

Workflow	Round 1	Round 2	Prototype
W1	x		
W2			x
W3	x		x
W4	x	x	x

Resources (Siebers 2023)

Engineering Agent-Based Social Simulations

User Guide v2023-02-21

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Brief Summary

What is it all about? What are successful model development strategies for complex social systems modeling? How does modelling work in large, collaborative, and multi-disciplinary projects in academia, non-governmental and governmental organisations, and industry? How do we derive new and general insights from modelling complex social systems? Anecdotal evidence suggests that the community of agent-based modellers partially suffers from a lack of structured and standardised ways for model development. In order to close this gap, we have created a model development framework, namely the Engineering Agent Based Social Simulation framework (or EABSS for short) which supports model development and model documentation in a structured way. Figure 1 shows a high level overview of the latest version of the framework. Full details together with an illustrative example can be found in Siebers and Klügl (2017) and some guidance on how to use the framework can be found in Appendix A.

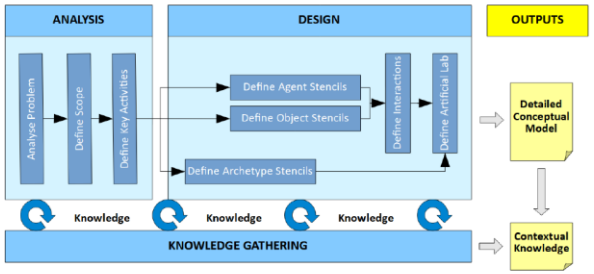

Figure 1: High level overview of the EABSS

How does it work? The EABSS is grounded in the concept of co-creation (Mitleton-Kelly 2003) and ideas from Software Engineering (Sommerville 2015). In addition it draws on elements of Kankainen's focus group approach to service design (Kankainen et al 2012). The framework implicitly provides ground rules, which is something commonly done when working with children but often forgotten when working with grownups. These grounded rules are in line with De Bono's philosophy of parallel thinking (De Bono 1985), and state that people are going to listen to each other and that people respect each other's point of view. To capture information it uses predefined table templates, and UML (a graphical notation used in Software Engineering) as main forms of stimulating and documenting contributions from all participating stakeholders during problem analysis and model design. It is this combination of tools and methods that makes it approachable for everyone.

use it? The EABSS can be used for two different purposes: (1) for collaborative model (from scratch or to extend/validate existing models) and (2) to stimulate and formally ussions about philosophical questions of societal issues that need to be addressed. We the framework in several domains, including Architecture, Geography, Organisational bers et al 2020), and Digital Mental Healthcare (Vallejos et al 2019; Siebert et al 2020; iebers 2020). It is designed with the aim to look at a complex system in more detail with step. There is always information from previous steps that can be used to get started t step. This principle serves validation, as getting stuck in the current step is a good t something in previous steps is not quite right and needs to be amended.

get out of it? The outcome of an EABSS session is a structured record of the key points of up discussions, in a format that is easy to understand by all stakeholders, and easy to a little effort this can often be translated into an agent-based social simulation model, en be used by the stakeholders as a "what-if" analysis tool.

xperience so far? Interestingly we found that each of the academics involved in running ups finds EABSS supportive in a different way, perhaps embedded within the research d in their domain. So the concept itself can be seen as interdisciplinary, while it was y intended to support social simulation model development. It has now been used for opment, reverse engineering of existing models for validity checking, discussions to ng models and confirm their validity, debates to analyse research topics and work on directions for research.

e going from here? More recently I got interested in the philosophical debates of Richard a German Philosopher who debates about "the digital revolution of society". I would like ABSS to test some of his future visions and to see if we can visualise his worlds with the . I would like to approach this in a more systematic way - i.e. to build a kind of toolbox s to build this new genre of models easier. In the end we could have a collection of at allow the community to put together models for tackling philosophical questions - rm of a toolbox as an extension to existing simulation packages.

ences

O and Siebers PO (2020) 'Opportunities for Using Agent-Based Social Simulation and Fuzzy ic to Improve the Understanding of Digital Mental Healthcare Scenarios'. In: Proceedings of 10th OR Society Simulation Workshop (SW20), 30 Mar-1 Apr, Loughborough, UK.

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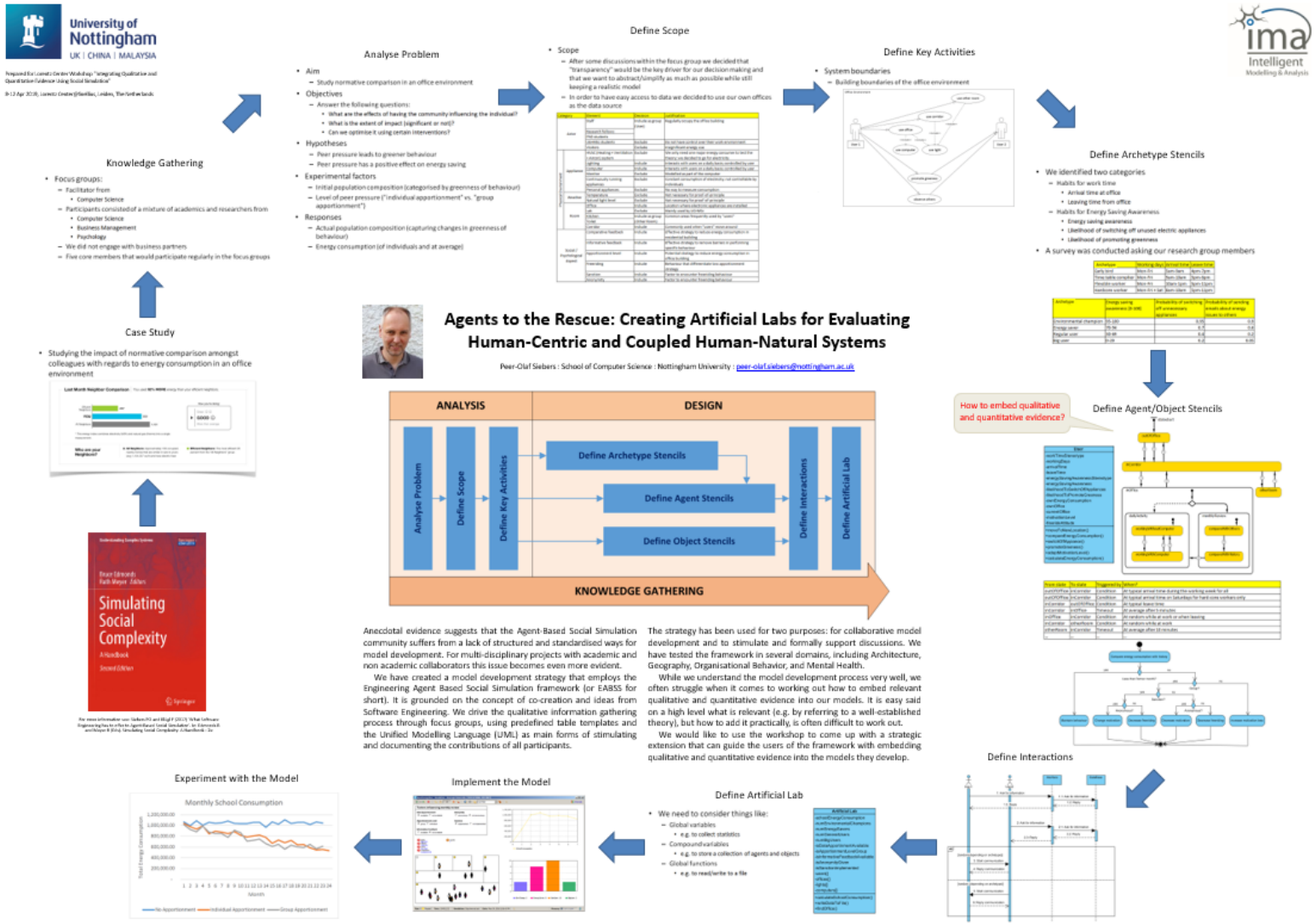
ABSS Guidance

remarks are meant to guide the focus group moderator regarding the re-use of le remarks list the tools to be used in that particular step

also clarify terminology and come up with a common pool of term definitions)
"Purpose" of the model
st of "Hypotheses" to be tested
ist of "Experimental Factors" to allow creating scenarios relevant to testing those es (look at objectives/hypotheses to work these out)
st of "Responses" to accept/reject hypotheses (look at objectives/hypotheses to work these out)
or nouns in previous text to find elements)
level of abstraction
es (key actors - represented by the role they play, and key objects) and concepts n also represent social/economic units, as for example families or firms)
these should be included/excluded in the model and justify your decision
efined table (headers: Category; Sub-Category; Element; Decision; Justification (while provided, sub-categories are flexible and depend on the context); categories: Actor; Physical ent; Social and Psychological Aspects; Other)
es (actors come from scope table; use cases come from hypotheses and by creating user stories)
actors to relevant activities (use cases)
use case diagram
Stencils (these allow to define behaviour of actors)
with categorisation schemata for relevant key actors (agents) that will allow to a simulated population into behaviourally different groups
template(s) and/or demographics and/or utility function(s)
nt/Object) Stencils (attributes can be derived from archetype criteria, theory parameters, methods can be the related state charts) (states can often be derived from use cases)
mplates by defining key states an entity can be in, how these are linked, and what ansitions (note that this might not be required for all entities)
les that ought to be tracked at the micro/meso level in order to gain insight about identified during the problem analysis
state machine diagram(s); transition table(s); class definition(s)/diagram(s)
s (all elements defined in the agent/object stencil step need to be listed on the horizontal axis) (use cases could be
quences of interactions that can take place between agents and between agents and specific use case realisations
sequence diagram(s)
b (attributes provide storage for all agents/objects and initialisation parameters required for experimental factors; oses)
es that need to be created; listing variables that ought to be tracked at the macro der to gain insight about the issues identified during the problem analysis
der of execution (if relevant)
class definition(s)/diagram(s) and sequence diagram(s)

Resources (Siebers 2019)



Any Questions?

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