

# EABSS Workshop 2023

## Co-Creation of Agent-Based Social Simulation Models

### Simulation Modelling Framework

# Simulation Modelling Paradigms

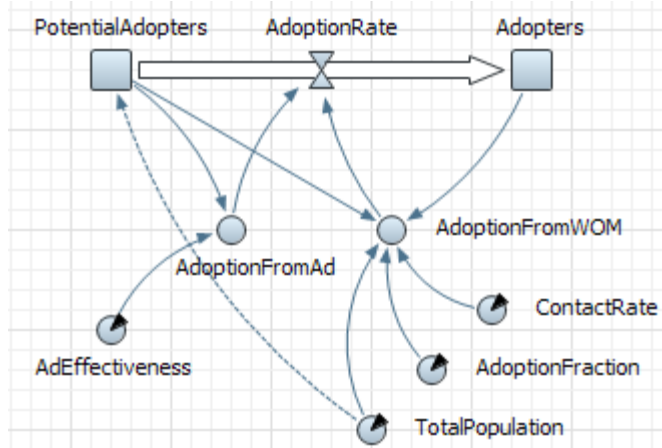


# Simulation Modelling Paradigms

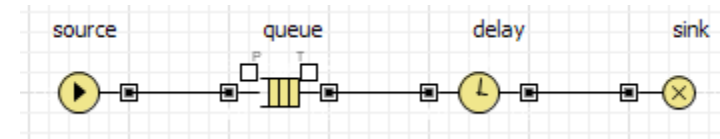
- System Dynamics Modelling (SDM) and Simulation (SDS)
  - Modelling: Causal Loop Diagrams + Stock and Flow Diagrams
  - Simulation: Deterministic continuous (differential equations)
- Discrete Event Modelling (DEM) and Simulation (DES)
  - Modelling: Process Flow Charts
  - Simulation: Stochastic discrete (process oriented approach)
- Agent Based Modelling (ABM) and Simulation (ABS)
  - Modelling: Equations or UML
  - Simulation: Stochastic discrete (object oriented approach)
- Hybrid Modelling (HM) and Simulation (HS)

# Simulation Modelling Paradigms

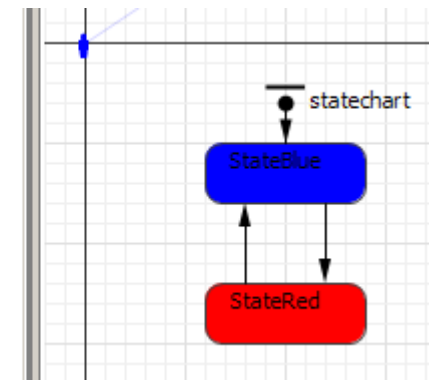
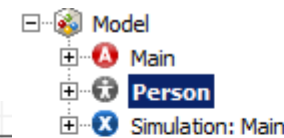
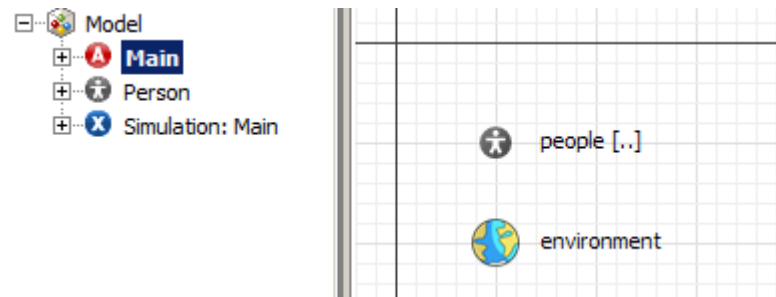
- SDM



- DEM

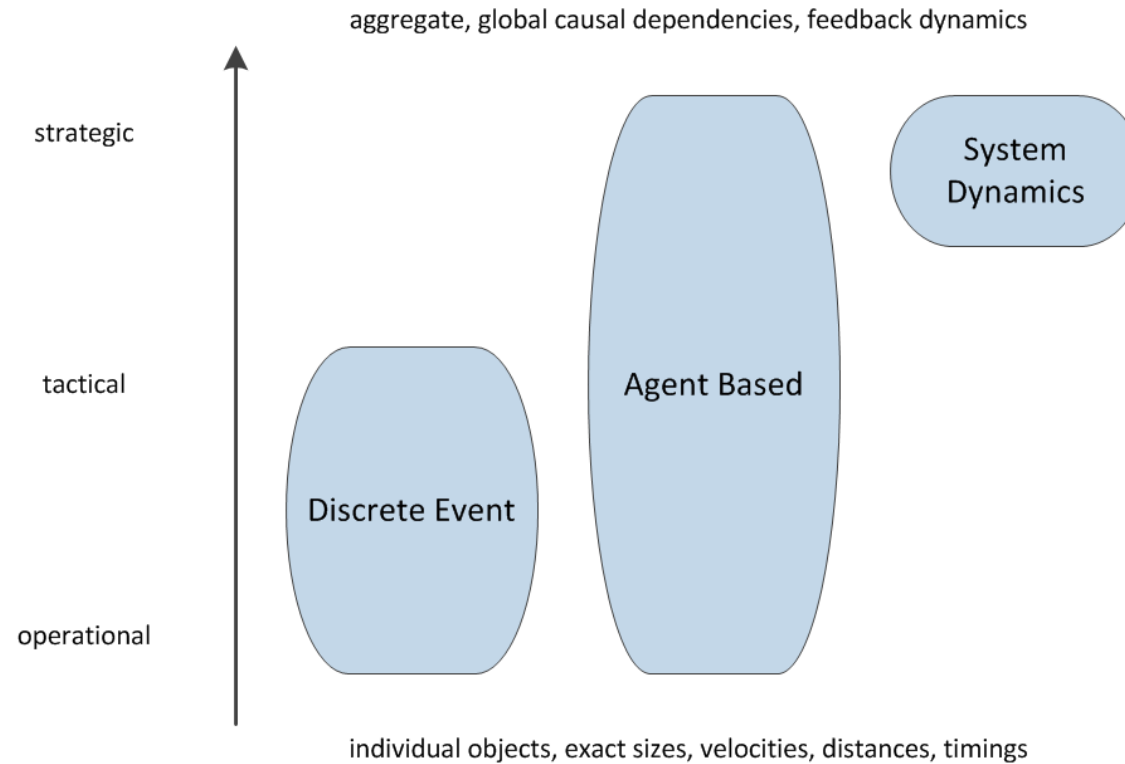


- ABM



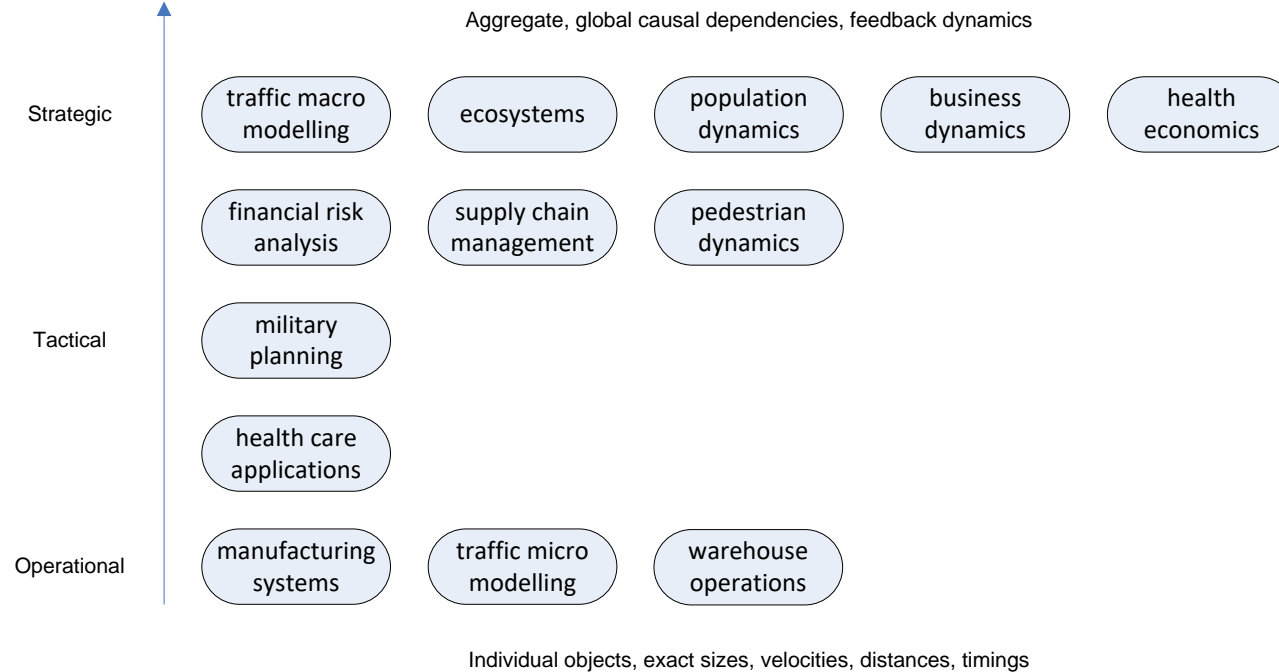
# Simulation Modelling Paradigms

- Level of abstraction vs. simulation modelling paradigms



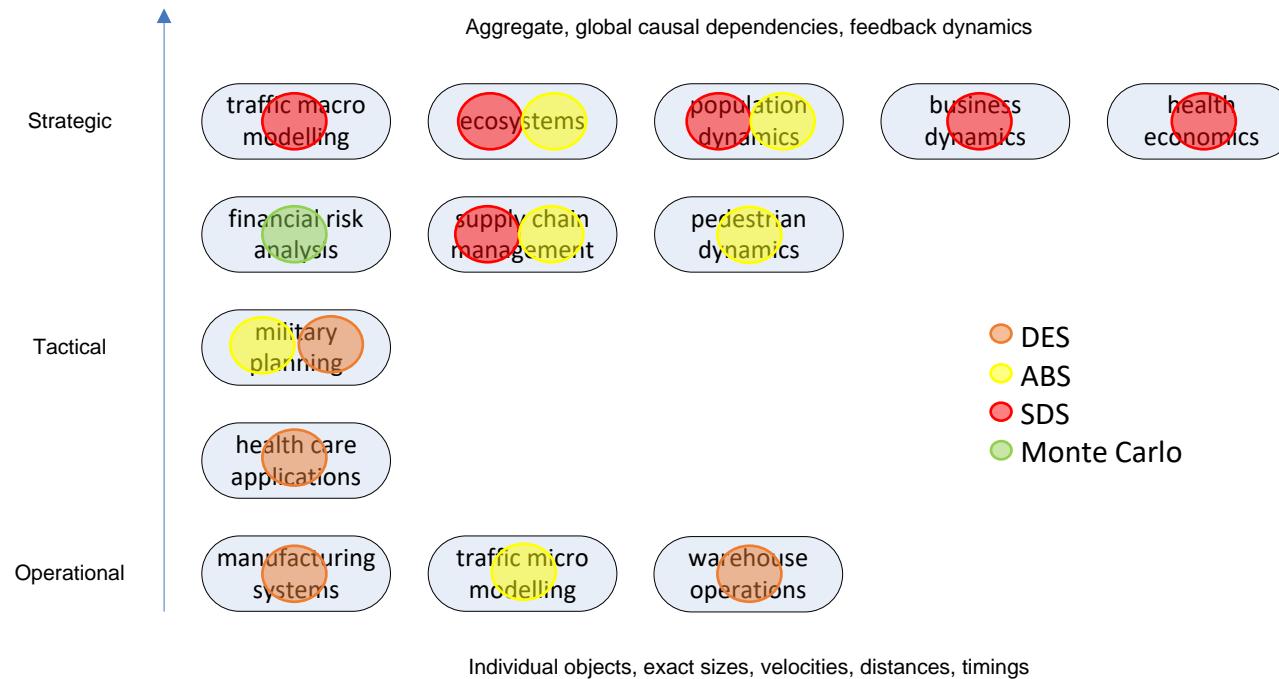
# Simulation Modelling Paradigms

- Level of abstraction vs. simulation modelling paradigms



# Simulation Modelling Paradigms

- Level of abstraction vs. simulation modelling paradigms



# Three Factors to Consider for the Choice of your Simulation Study Approach





# Factor 1: Purpose of Study

- Exploratory
  - Seeks to define research questions of a subsequent study or to determine the **feasibility of research procedures**
    - Supports initial research into a hypothetical or theoretical idea
- Explanatory
  - Seeks to determine how events occur and which ones may influence particular outcomes (**establish cause-and-effect relationships**)
    - Can only be applied once we have accumulated enough knowledge to make predictions with some accuracy
- Foresight or Predictive
  - Seeks to make **empirical predictions** regarding future events of interest in a complex world
    - <https://yskills.eu/what-can-we-learn-from-evidence-based-explanatory-and-foresight-models/>

# Factor 2: Drivers of Model Formulation

- Theory driven
  - Theory for model formulation
  - Data (or expert opinion) for model calibration/validation
- Data driven
  - Data for model formulation (qualitative or quantitative)
  - Data (or expert opinion) for model validation
- Logic driven
  - Logic for model formulation
  - Data (or expert opinion) for model validation

# Factor 3: Domain

- Typical simulation study characteristics in different domains

Operations Research	Business, Economics, Social Science
Empirical basis	Theoretical basis
Improving the real world	Thinking about the real world
Data collection and analysis	Dynamic hypothesis
Validation: Sufficient accuracy for purpose	Plausibility: Seeming reasonable or probable
Implementing findings	Learning + understanding

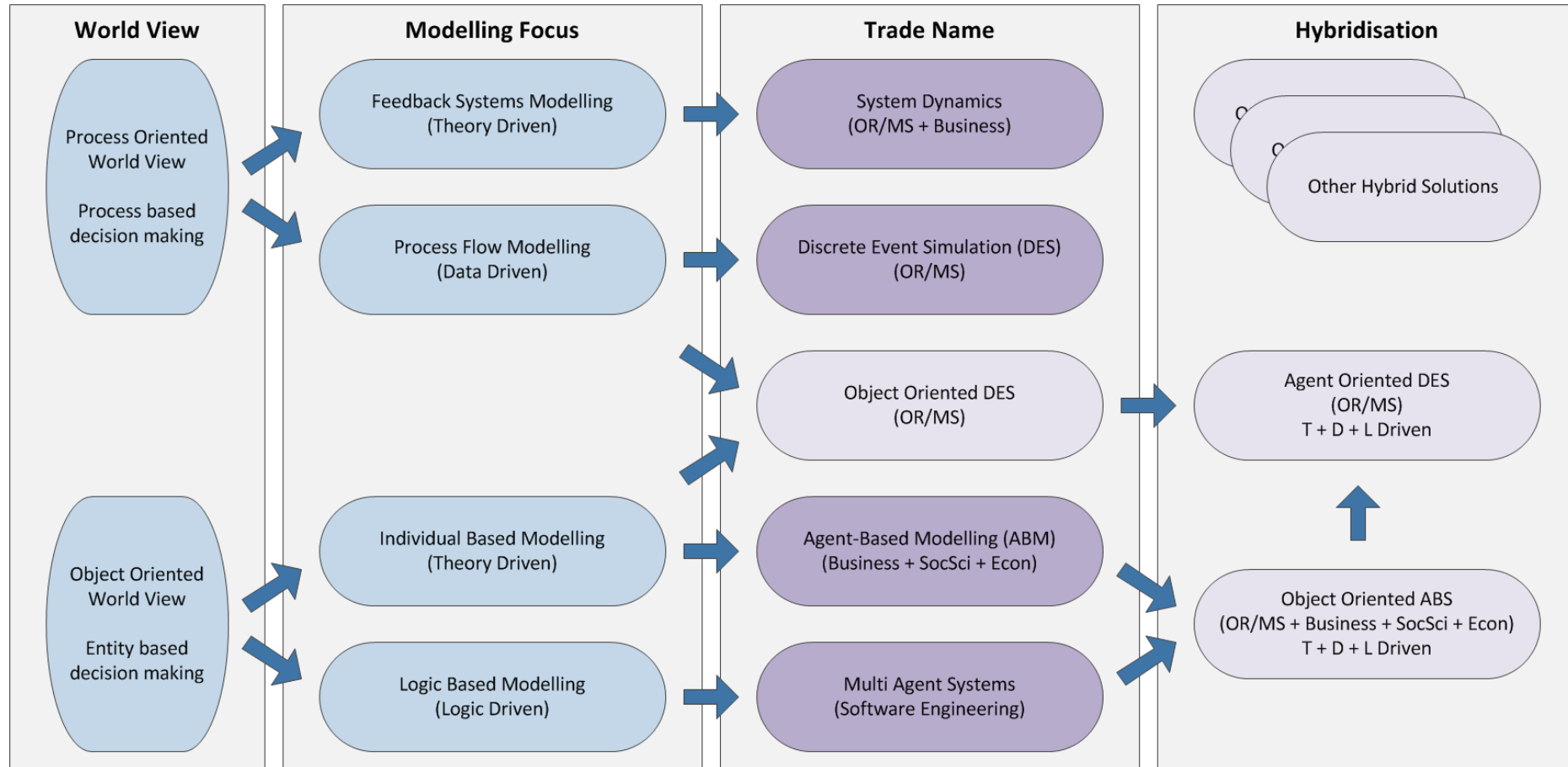
after Robinson (2011)



# Simulation Modelling Framework



# Simulation Modelling Framework



Theory Driven: Theories for model formulation; data for model validation  
 Data Driven: Data for model formulation (can be quantitative and qualitative); data for model validation  
 Logic Driven: Logic for model formulation; data for model validation

Any Questions?



# References

- Robinson (2011) Are ABS and OR commensurable paradigms (ORSimSIG presentation)
- Siebers PO (2023) 'Everything you always wanted to know about Dr Siebers (academic details only :) - 2nd Edition', In: Proceedings of the 11th OR Society Simulation Workshop (SW23), 27-29 Mar, Southampton, UK.