Summary of the 1st survey input

(The 2nd in the State of the art paper)

Q2 (Areas where ABM is powerful)

Feedback and interactions (Barton, Deadman, Jankowski, KLacasse, Liu, Manson, Nara, Radchuk, Robinson, Turner, Walsh)

Non-linearity (Nara, DP)

Complex/adaptive systems (Nara, Robinson, Schlueter, DP, Turner, Zellner)

Social network: (Barton; Galesic: spread, evolution, *cooperation and conflict*; manson);

Modeling of Decision making and impacts (Barton, Deadman, Schlueter, Verburg)

Spatial explicit modeling (Rey)

Heterogeneity (Barton, Dou, Schlueter, DP)

Learning process (Barton)

Human-environment system (LU) (Barton, Clarke, Deadman, Liu, Manson, Walsh)

Communication with stakeholders (storylines; Dou, Schlueter)

Resilience or adaptation to climate change (Dou)

Effects of individual variation and coevolving traits (Eliassen)

Behavioral choices of animals (Eliassen)

Land use/Land cover change (Clarke, Evans),

Food security (Evans),

Water security (Evans),

Urban growth/dynamics (Evans, Nara)

Impact of policy (Heppenstall)

Health behavior with input from psychology and big data (Heppenstall)

Individual behavior and interaction with the environment (Heppenstall)

New knowledge and system understanding (Heppenstall)

Energy consumption prediction of connected electronic devices (Huang)

Simulate non-linear processes/systems (Jankowski)

Tipping points (Jassen)

Consequences of various assumptions (Jassen)

Dataset based theory test (Jassen)

Scale up (individual process -> collective outcome; micro -> macro) (KLacasse, Schlueter)

Reproduce/simulation of pattern/consequences (Kohler: archaeology; Zellner)

Counterfactual simulation (Rey)

Long term, evolutionary questions (Sullivan: institutions)

Transdisciplinary research (Tesfatsion)

Computation laboratory (Verburg)

Information diffusion (Ye: disaster warning, controversial social topics)

Q3 (Issues or challenges that ABM can help but not done well)

Feedback and interactions (Barton: between anthropogenic and biophysical processes;)

Dynamics of urban systems (Barton)

Simulation experiment with slow speed/multi-replications needed (Barton)

Massive ABM (Barton), # of agents (Barton, Keith), big data ABM (Heppenstall)

Connecting different models (Barton: human decision & large-scale earth system)

Model validation (Clarke; Evans; Heppenstall; Tesfatsion)

Calibrate and parameterize ABM (Clarke; Evans; Heppenstall)

Model uncertainty and nonlinearity (Clarke; Deadman; Walsh)

Learning of agents (Clarke)

Form large and communicative community (Clarke)

Ensemble modelling (Deadman)

More realistic decision making rules—e.g., generic algorithm (Dou)

Cross scale or system simulation (Dou)

No ABMs addressing general patterns and relationships (too site specific) (Eliassen); Lack of general purpose ABM modeling software (Piotr)

More on organisms' behavioral mechanisms and trade-off (Eliassen)

Apply social Network analysis in ABM (Manson)

More realistic, yet simple cognitive models of agents (Galesic)

Cognitive scientists and social network experts join ABMers (Galesic)

Visualization (Heppenstall)

Efficiency of portable computing devices (Huang)

Develop user-friendly ABM interface (Huang)

Implement hardware-friendly algorithms (Huang)

Lack of capacity of computational literacy (Janssen)

Lack the right type of data (Janssen; Sullivan: longitudinal and cross-site human-environment datasets; Ye)

Lack of training in ABM (KLacasse: in psychology)/ Computing (KLacasse: in social science); difficult to learn (Zellner)

Experimentation based on data not provided by actual human participants (KLacasse)

Climatically modulated agricultural productivity/sensitivity of ancient populations to climate change (Kohler)

Telecoupling (socioeconomic and environmental interactions over distances) (Liu)

Large scale simulation/individual data (Nara)

Spatio-temporal analysis / little interaction between geovisualization people and spatial data analysis folks (Rey)

Site location choices (Robinson)

Model reuse and sharing (Robinson)

Stakeholder involvement (Robinson)

HPC (Robinson)

Centralized and standardized way of sharing and merging datasets (Sullivan)

Standardized protocols for model presentation (Tesfatsion)

Making assumptions not from the empirical world (Turner)

Scaling ABM to larger scales (Verburg)

Pattern-process understanding (Walsh)

Sensitivity analysis (Walsh)

Scale dependence (Walsh)

Simulate the distribution of information (Ye)

Q4 (ABM development challenges)

1) Difficulty in Parallel ABM (Axtell; Evans)

2) Short of funding support (Axtell)

3) Short of micro data for model calibration/parameterization (Axtell; Heppenstall; Nara; Radchuk)

4) Formulate appropriate rules for agents

5) High program skills

6) Team science (Barton)

7) Short of model verification tools (Barton)

8) Lack of APIs connecting codes or components (Barton)

9) Code transparency and reusability (Barton; Dou; Janssen; Radchuk; Schlueter; Parker; Tang)

10) Integration with GIS (Keith)

11) Agent visualization (Keith),

12) Model/module reusability and standardization (Keith; Grimm; Robinson; Tesfatsion)

13) Uncertainties and mechanisms of decision rules/models (Deadman; Dou); computational models of human behavior (Janssen)

14) Data deficiency (Dou); Employ different types of data (Janssen);

15) Math model for missing data (Dou)

16) Agent functional type (Dou)

17) Ensemble approach for decision making (Dou)

18) Draw cognitive maps of decision making (Dou)

19) User friendly tools (Evans)

20) Platform performance/stability (Evans; Manson: NetLogo)

21) Protocol development for communication, testing, and analysis (Grimm; Sullivan)

22) Model evaluation methods/metrics such as generating confidence levels (Heppenstall).

23) Include cross scale processes in ABM (Heppenstall)

24) Big data for ABM parameters and rules (Heppenstall)

25) Model calibration and validation (Janssen; Schlueter; Walsh: process vs. pattern)

26) lack of models for macro-level dynamics of social and political dynamics (Janssen).

27) High performance computing techniques (Nara; Shook)

28) Lack of well trained developers (Radchuk: in ecology and biology; Robinson)

29) Model adaptive behaviors (Railsback)

30) Link of model to theory and empirical research (Schlueter)

31) Lack simultaneous support for 1) spatial data, 2) spatial analytics, and 3) large simulation (Shook)

32) Lack of technical support for model development (Sullivan)

33) Lack of diversity (gender, race, ethnicity, etc.) in the ABM community (Sullivan)

34) Lack of access to programming classes (Parker)

35) Model conceptualization (Tian)

36) Scaling issues (Verburg)

37) Little done in terms of generalizing approaches to modeling specific processes (Zellner)

Q5 (How to address the Q4 challenges)

1) Agent-oriented OS (Rob), platform for semi-automated code (from large datasets and concepts)

2) Reusable ABM modules or libraries

3) Develop ABM software (Keith; Dou with GUI and drag-add)

4) Top 20 papers as ABM resources (Keith)

5) Ensemble of decision making models (Deadman).

6) Repertoire (database) of agent function types (Dow)

7) Companion modeling (Dou)

8) Teamwork on sample code and documentation (Evans)

9) Cognitive scientists, social scientists, and computer scientists work together (Galesic)

10) develop realistic but simple ABMs of social cognitive processes on networks (Galesic)

11) Empirical data collection for parameterization/testing (Galesic; Schlueter)

12) Protocol development for communication, testing, and analysis (Grimm)

13) More development on Netlogo (Grimm; Railsback)

14) Develop frameworks for exploring "Agent-based Complex System" and predictive theories (Grimm)

15) Multi-disciplinary team a) evaluating ABM output (across scales); b) building ensemble models; c) assessing confidence levels; c) building toy models (Heppenstall)

16) Sociologist-geographer conversation (ABM output agrees with social theory) (Heppenstall)

17) Develop cyber infrastructure (Janssen; Tang)

18) Request code and documentation (Janssen)

19) Develop testbed cases with multi-group and multi method input (Janssen)

20) Collaboration of ABM and cognitive and social scientists (Janssen)

21) Organize ABM workshops/programing training for social/biological scientists (Janssen; Radchuk; Robinson)

22) Collect /purchase/develop big data /databases across taxa (Nara; Radchuk)

23) Hire good programmers (Nara)

24) Do a real structural sensitivity analysis (Schlueter; Tian)

25) Create a new spatially explicit ABM framework with spatial methods at the center (Shook)

26) Examining the influence of spatial and temporal scales in ABM (Shook)

27) Standard online community of scientific ABMs (Sullivan)

28) Develop upon existing model platforms/language, technical support team (Parker)

29) Start a certificate program (Parker)

30) Develop state of art cyberinfrastructure-enabled computational platforms (Tang)

31) Develop a supporting agent-based test system (Tesfatsion)

32) Test and compare different upscaling strategies (Verburg)