The Engineering Agent-Based Social Simulation Framework: A Key to Unlocking Agent-Based Modelling in B2B Research?

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Business models function as blueprints for a firm's operations, offering a representation of the value creation and capture processes (Osterwalder et al. 2005). Managers, policymakers, and academics use these models as they provide a structured approach to analysing a business, identifying opportunities, and guiding strategic decision-making. Despite the claims that business models are dynamic (e.g. Achtenhagen et al 2013), they only capture a snapshot of how a system works at a specific point in time, neglecting the dynamic nature of the competitive landscape and internal operations. Their inherent static nature presents a limitation.

One way of overcoming this limitation is by integrating business models with data analytics (Ochuba et al 2024). Data analytics empowers researchers and practitioners to identify patterns and relationships within historical data sets. By analysing the impact of past marketing budget allocations on sales figures, for instance, data analytics can inform predictions about the potential effects of future budget adjustments. However, data analytics is primarily suited for studying existing systems with readily available data, often functioning within the confines of input/output models.

Simulation as a tool addresses this limitation by incorporating the dynamic nature of complex systems over time (Siebers and Aickelin 2008). This allows researchers and practitioners to investigate how a business or an entire value chain might evolve over time in response to various scenarios and enables a more comprehensive understanding of a business model's strengths, weaknesses, and adaptability in a constantly evolving environment.

The aim of the research presented in this paper is to explore opportunities for the application of ABM in B2B studies and to test if the EABSS framework, designed for developing social simulation models can also be used for developing B2B simulation models.

Agent-Based Modelling (ABM) is a simulation modelling approach used in the Social Sciences, Economics, and Operations Research, amongst others. In ABM, a system is modelled as a collection of autonomous decision-making entities called agents. Each agent individually assesses its situation and makes decisions on the basis of a set of rules (Bonabeau 2002). In this context, the term 'agent' refers to an individual, household, firm, organisation, or institution. ABM is well suited to modelling systems with heterogeneous, autonomous and proactive actors, such as Business, Enterprise, and Marketing Systems.

In regard to Business-2-Business (B2B), ABM can be a powerful tool for strategic planning by simulating the complex interactions within a target market and an organisation (Onggo and Foramitti 2021). Following are some examples of how ABM can be applied to B2B value creation modelling: *Understanding Customer Behavior*: B2B customers are often complex entities with diverse needs and decision-making processes. ABM allows to create agent models representing different types of customer organisations. These agents can be programmed to consider factors like budget constraints, technical requirements, internal approval processes, and competitor offerings. By simulating their interactions with products, services, and marketing messages, ABM can help predict customer behaviour and optimise B2B strategies. *Evaluating Market Dynamics*: B2B markets are dynamic with competition, new technologies, and evolving customer needs. ABM can simulate these market forces. Agents representing competitors can be programmed with different pricing strategies, product features, and marketing tactics. By observing how these agents interact with your own and with potential customers, ABM can reveal emerging trends, potential threats, and opportunities for your B2B strategy. *Exploring the Impact of Decisions*: B2B strategic decisions can have ripple effects across the market. ABM allows you to experiment with different strategies in a simulated environment. One can model the impact of changes like pricing

adjustments, new product launches, or expanded distribution channels. This can help to predict the potential outcomes of your strategic decisions and identify the most effective course of action. *Optimising Sales and Marketing Strategies*: B2B sales cycles can be complex, often involving multiple decision-makers within customer organisations. ABM can simulate these internal dynamics. Agents representing different stakeholders within a customer organisation can be programmed with different priorities and budget constraints. By analysing how these agents interact with sales and marketing efforts, ABM can help identify the most effective targeting strategies and tailored messaging to win deals in B2B markets.

Despite the clear potential of ABM in B2B research and management, its adoption remains limited. Interest from colleagues is evident, but designing ABMs is perceived as a significant hurdle. To address these challenges, the Engineering Agent-Based Social Simulation (EABSS) framework by Siebers and Klügl (2017) offers a promising solution. This is a co-creation tool that was originally been developed for use in the Computational Social Science domain, but has been applied in many other domains vas well (Siebers 2023).

The EABSS framework leverages co-creation and Software Engineering principles to facilitate collaborative problem-solving. It incorporates elements from Kankainen's focus group approach for service design. Uniquely, the framework establishes ground rules for respectful listening and consideration of diverse viewpoints, like approaches used with children but often overlooked with adults. This aligns with De Bono's parallel thinking (De Bono 1985). To capture information in a structured way, the EABSS framework utilises pre-defined tables and UML (a graphical software engineering notation) to encourage and document contributions from all stakeholders during analysis and design phases. This combination of methods ensures the framework is accessible and fosters participation from everyone involved. The outcome of an EABSS session is a structured record of the key points of the focus group discussions. With a little effort, this can often be translated into an agent-based social simulation model, which can then be used as a "what-if" analysis tool.

While social simulation focuses on understanding emergent social behaviours from interactions between social entities, B2B applications leverage ABM to optimise business strategies. Here, agents represent B2B entities (e.g. customer organisations, competitors). Their decision-making processes are guided by economic factors and business logic.

To test if the EABSS framework can also be used for developing B2B ABMs the author together with a Marketing expert have jointly conducted a test run. The aim of the case study used for the test run is to better understand the dynamics of the adoption of the Paga banking system in Nigeria (Ehret and Olanyian 2023). Paga is a mobile payment platform based in Nigeria. It allows users to make payments, transfer money, and perform other financial transactions using their mobile devices. Paga serves as a digital wallet that enables individuals to link their bank accounts and make transactions without the need for physical cash. Users can access Paga services through a mobile app or by visiting authorised Paga agents.

The research described in this paper is still ongoing. Our finding, after a first round of using the EABSS framework for this test case, is that the EABSS can be used directly for co-creating B2B ABMs, without requiring adaptations for B2B use cases. Notably, it also aids in the development of a joint understanding of the test case, something vital when the co-creation participants are from different disciplines.

Our next step is to create a simulation model from the conceptual ABM we developed. As the EABSS output delivers clear guidance for the model implementation, our hypothesis is that the implementation should be straightforward. Future work includes the execution of further case studies and the use of Generative AI to automate conceptual ABM and implementation.

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