Journal of Systems Thinking in Practice
JSTINP, *QUARTERLY*
Homepage: jstinp.um.ac.ir
Online ISSN: 2821-1669, Print ISSN: 2980-9460
Research Article
DOI: 10.22067/JSTINP.2025.95251.1175
JSTINP 2026; Vol. 5, No. 1

Modeling Platform Business Growth Using Open Innovation and Agent-Based Approach

Reza Ameri Siyahooei*[a], Masoumeh Hosseinzadeh Shahri[a]

[a] *Department of Management, Faculty of Social Sciences and Economics, Alzahra University, Tehran, Iran.*

How to cite this article

Amerisiyahooei, R. and Hosseinzadeh Shahri, M., 2025. Modeling Platform Business Growth Using Open Innovation and Agent-Based Approach. *Journal of Systems Thinking in Practice*, *5*(1), pp.105 -125. doi: 10.22067/jstinp.2025.95251.1175.
URL: https://jstinp.um.ac.ir/article_47579.html.

A B S T R A C T

Open innovation is increasingly recognized as a critical factor in the growth of platform businesses, while agent-based modeling offers a practical approach to exploring development scenarios due to the complexity and dynamic nature of these businesses. In this study, agents are classified as service receivers or service providers. Service receivers are further classified as interactive/analytical or normal/indifferent, whereas service providers are identified as active/interactive or normal/indifferent. These classifications account for all dimensions of participation and the platform's operational environment.

Platform–agent interactions are modeled using attraction, facilitation, and adaptation mechanisms, whereas agent–agent interactions are defined by positive or negative impacts. The model was designed using the Taguchi experimental design method (Qualitek software) to generate four-level scenarios for key indicators, including Absorptive capacity, networking and network management, knowledge and technical capacity, and collaborative capability. The scenarios were then simulated using AnyLogic.

Results indicate that the optimal levels for attraction, networking, and technical capacity correspond to the fourth level, while the third level is optimal for collaborative capability. The simulation further demonstrates that implementing the optimal scenario enhances overall platform performance, yielding a value of 0.957. These findings provide practical insights for managing platform-based businesses and contribute to a better understanding of how to integrate open innovation with agent-based modeling to optimize platform growth.

Keywords

Scenario, Platform Development, Open innovation, Agent-Based simulation, Businesses development.

Article history

Received: 2025-09-4
Revised: 2025-11-06
Accepted: 2025-11-26
Published (Online): 2026-3-20

Number of Figures: 5 **Number of Tables: 6** **Number of Pages: 21** **Number of References:66**

****Corresponding author***
Email: R.amerisiyahoei@alzahra.ac.ir

1. Introduction

Over the past few years, the structure of businesses has changed from traditional structures to a platform. Alstyne and Parker (2017) define platform business as a new business model that applies technology for making an interactive connection between people, organizations, and resources that results in Value creation.

Platforms play a fundamental role in connecting service providers and receivers (Rochet and Tirole, 2003), and platform businesses can create many opportunities that provide a new ground for exchanging information and services and act as a critical driver for socio-economic change (Meijerink and Keegan, 2019). It is critically important to develop an appropriate approach to building platform businesses in a highly competitive and dynamic world.

Platform development has not been properly investigated though such important issues have been explored as the nature of platform, the strategy and Dynamicsof platforms (Wan et al., 2017), the consequences of using platform (Gawer and Cusumano, 2014), platform leadership (Eisenmann et al., 2011), challenges and structural problems of platform (Hagiu and Wright, 2015). Moreover, Skold and Karlsson (2012) and Jagstedt and Persson (2019) argue that platform development has not been properly understood, and that further investigation is required to clarify the issue. Idea development refers to activities that lead to business development (Golembiewski, 2017). Among the things that may help platform businesses to achieve their development is open innovation.

Open innovation enables platform businesses to enhance their competences. It is evident that, given the context and activities of platform businesses, open innovation may be an effective solution to various challenges. Open innovation aims to leverage others' findings in innovation processes through formal or informal channels (Schwab et al., 2011). Huizingh (2011) believes that open innovation initiatives are processes taken by managers for making decisions about the time, way, aim, and method of cooperating with other partners.

Open innovation is now evidently playing a significant role in developing platform businesses, but A precise model is needed to be designed. Simulation method is a highly effective toolfor designing the model and identifying optimal scenarios to improve the business process (Keller, 2004). Given the system's complexity, this study employs an agent-based simulation as a practical solution. This method is a useful approach to modeling complex systems and phenomena, as it enables designers to model the system by identifying the rules governing agent behavior and to analyze and assess the behavior of the whole system as the model output. In agent-based modeling, researchers can simulate their optimal model, Conduct experiments on the designed model, present experts' opinions in the form of different scenarios (Billari, 2015; Tylor, 2014; Silverman et al., 2013), and at the end, choose the best solution from among the proposed scenarios and implement it.

Given the rapid growth and strategic significance of platform businesses, understanding how to achieve sustainable, value-creating development remains a major challenge, owing to the complexity and dynamism of these markets. This study addresses this challenge by integrating open innovation with agent-based modeling, providing both theoretical insights and practical guidance for platform managers. The primary objective of the research is to identify and evaluate platform development scenarios and select the optimal strategy that maximizes value creation. To achieve this, the research procedure comprises three main steps: first, platform development scenarios are defined through open innovation; second, these scenarios are formulated and analyzed in AnyLogic; and third, the modeling method is applied to select the scenario with the highest overall desirability. The findings of this study contribute to a better understanding of platform development processes and offer actionable insights for managers seeking to optimize performance and growth in platform-based businesses.

2. Literature review and hypothesis development

2.1. Platform development

Platform businesses are among the business models that have attracted the attention of many entrepreneurs. Platform is a broad, flexible concept; that is, different things for specific applications can be considered as a platform. A platform is defined as a set of hardware, software, and operating systems that the platform itself is a member of the software (Jovanovic et al., 2022). Platforms provide the rules and infrastructures that facilitate interactions and reduce transaction costs and inefficiencies. Moreover, platforms enable us to communicate with people who are not close to us and to overcome the obstacles of previous years (Aloisi, 2016). They enable a two-way or multi-way communication with a specific goal (Huotari and Ritala, 2017).

Since the number of platform businesses has increased over the last few decades (Yablonsky, 2018), going towards developing platform businesses is imperative. Business development mechanism consists of a set of solutions that facilitate business development and make the ground for entrepreneurs to improve their competitive position in the market.

To determine the platform development framework, first identify and conceptualize the requirements, then design a model to guide the platform's development. As such, businesses like platform businesses operate in dynamic markets, they face serious challenges for achieving success, and innovation can be the main solution. Simple innovation and established research patterns, with closed boundaries on innovation and foreign knowledge in the current context, would not be sufficient. A proposed model in this regard is open innovation (Bigliardi and Dormio, 2012). It can also be said that research such as Mady et al. (2025), Nagy et al. (2025), Li et al. (2025), Topalova et al. (2024), Raco et al. (2024) is mentioned in regard to Platform development.

2.2. Open innovation

The increasing changes in business and competitiveness have led people to pay greater attention to the role of innovation in business development. In this regard, open innovation was proposed in the early 2000s that is now considered a new innovation paradigm (Virlee et al., 2015).

Today, applying open innovation is a must. It is the main driver of development and creation of competitiveness, and a phenomenon that gains importance for platform businesses increasingly. Open innovation is now increasingly used in many modern industries, such as software (Henkel, 2006; Pykalainen, 2007; West and Gallagher, 2006) and electronics (Chesbrough, 200٦). It originates from a way of thinking and refers to businesses' simultaneous use of outward and inward knowledge flows to strengthen internal innovation and external use (Chesbrough, 2017). The main logic of open innovation is managing the inbound mainstream (inbound open innovation) and outbound (outbound open innovation), information, knowledge, and technology, skills, and infrastructures for improving the internal innovation and maximizing the use of external innovation in all types of businesses (Cheng and Shiu, 2015). Chesbrough (2006) believes that open innovation is the purposeful use of incoming (internal) and outgoing (external) flows of knowledge for accelerating innovation in the market and as well as increasing the use of internal knowledge in external markets. These attitudes towards innovation remove the clear boundary between a company and its environment, so its clear and hard boundary fades (Chesbrough, 2006). It is noteworthy that open innovation is an overarching subject and covers a wide range of concepts, but all structures can not necessarily be adapted to the open innovation. So, applying open innovation to businesses is far more than applying a simple management tool, but it requires adapting the business model with the adopted strategy. Considering the aim of this research that focuses on the developing platform businesses and also considering the nature of open innovation, the framework used in this study is agent-based modeling. The aim is to present a comprehensive and accurate perspective for improving decision-making and planning for the development of platforms and boosting their performance. It can also be said that research such as Sá et al. (2025), do Prado et al. (2025), Obradović et al. (2021), and Barlatier et al. (2023) is mentioned in regard to open innovation.

2.3. Agent-based modeling

Simulation means Replicating systems in various scenarios (Brailsford et al., 2018) and simulation techniques are very useful for identifying the alternative scenarios of improving businesses' process (Keller, 2004). Simulation models provide the opportunity of having various decisions and analyzing their results with the aim of helping managers in making their decisions. In this regard, agent-based modeling offers features suitable for simulating complex social phenomena. It models clearly producing macro-level patterns by behaviors and also the interaction of people at the micro-level. It is a bottom-up modeling approach, as it focuses on the behavior of individual objects to derive the overall model. In agent-based modeling, by using simple decision-making rules, one can describe complicated business phenomena (Epstein and Axtell, 1996). According to Crooks and Heppenstall (2012), agent-based modeling allows simulating the individual actions of various agents and assess the behavior and results of the system over time. The purpose of agent modeling is to trace interactions among agents in their virtual environment and to identify approaches that emerge from general behavioral patterns (Sawhney et al., 2003).

According to Crooks et al. (2017), the most significant components of an agent-based model are: Agents (the autonomous and independent component that have specific features, actions, and goals); the modeling space (embraces all components of a modeling system except for agents), interactions and communications between agents, environment, and agents (interactions are non-linear as the overall behavior does not equal to the sum of the behavior of all agents and the interactions are done by information exchange); the decision-making procedure of agents (based on their limited rationality); the rules about the decisions of every agent (learning or adaptation). It is worth noting that for simulating agent-based models, software such as REPAST, SWARM, MASON, NETLOG, ANYLOGIC, and JADE can be used. Each software has advantages and disadvantages and is used based on users' goals. AnyLogic was used for this study. This software has a suitable graphic environment and can be used for both agent-based models and dynamic systems, and as many users have applied the software, it has been promoted; moreover, the user can easily get output from this software. It can also be said that research such as Rodríguez-Arias et al. (2025), Manhães et al. (2025), (Stummer, 2024), Čeh et al. (2022) is mentioned in the regard Agent-based modeling.

3. Methods

The study procedure, following the problem statement and identification of research objectives, is summarized in Figure 1. The expert population consisted of specialists in platform businesses, open innovation, and managers with practical experience in platform operations. Participants were selected through purposive sampling and snowball sampling.

Step 1: Defining agents and interactions: Agents were classified as service receivers or service providers. Service receivers were further classified as interactive/analytical or normal/indifferent, while service providers were classified as active/interactive or normal/indifferent. Interactions were modeled at two levels: Platform–agent interactions, represented through attraction, facilitation, and adaptation mechanisms. Agent–agent interactions are determined based on positive and negative impacts. The operational environment and all dimensions of participation were also defined.

Step 2: Formulating scenarios of platform development. Key development indicators for platform businesses that rely on open innovation were identified through an extensive literature review. Scenarios were designed using the Taguchi experimental design method and implemented in Qualitek software. Factors and their four levels were defined to represent various combinations of Absorptive capacity, networking and network management, knowledge and technical capacity, and collaborative capability.

Step 3: Designing the simulation model and implementing scenarios. An agent-based simulation model was developed using AnyLogic software, based on the conceptual framework of the study. Each scenario was implemented in the simulation environment, run, and its effectiveness evaluated.

Step 4: Selecting the optimal scenario: Simulation results for each scenario were analyzed using the Taguchi method in Qualitek to determine the optimal level for each development indicator. The scenario that maximized the created value metric in the platform environment was identified as the optimal scenario.

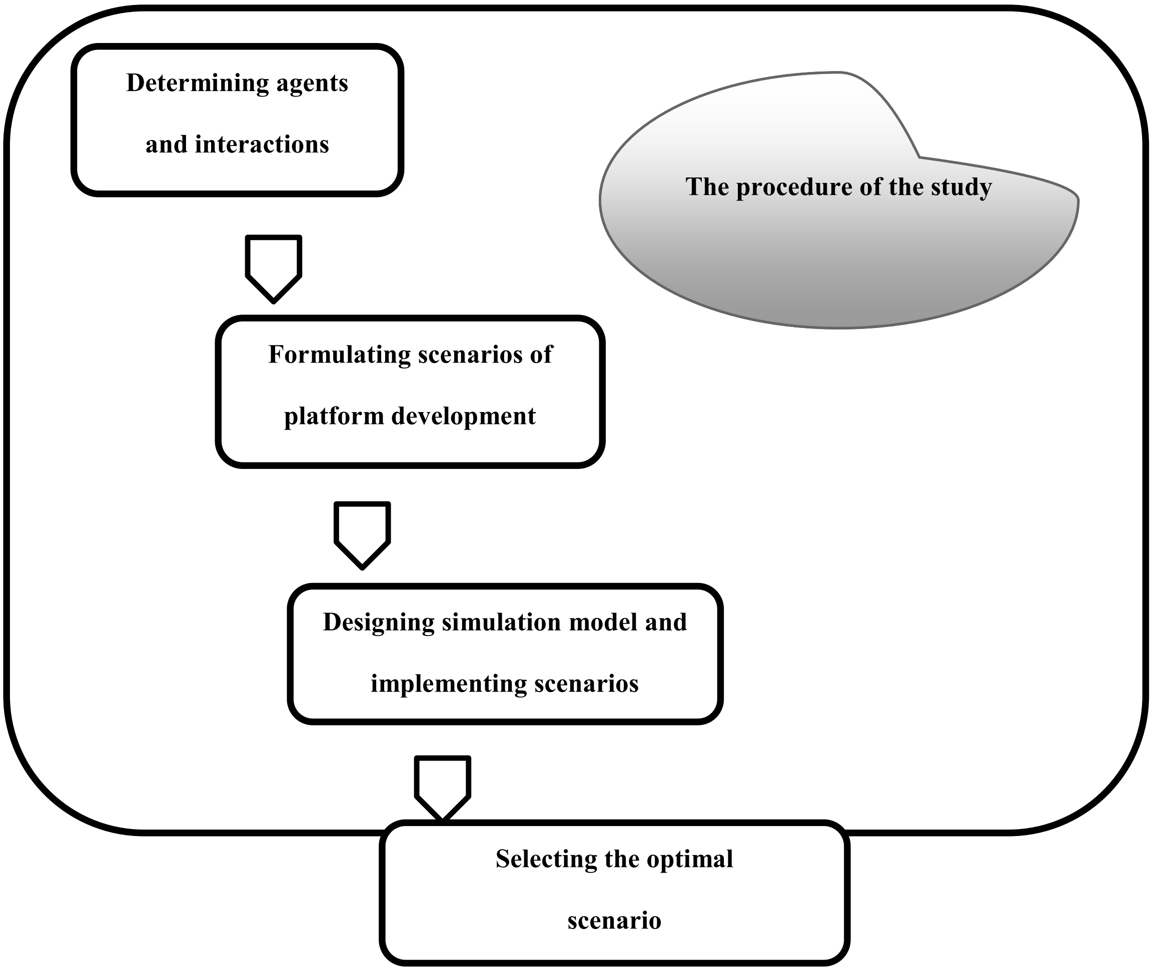

Figure 1. The procedure of the study

4. Results

4.1. Determining agents

Agents may have different roles in the model. In this study, agents served as both service receivers and service providers. Service receivers showed, based on collaborative behavior, specific behaviors in terms of information searching, responsible behavior, personal interaction, and service providers regarding collaborative behavior have specific characteristics in terms of aspects of responsible behavior, personal interaction, informational behavior, and altruistic behavior (taken from such studies as Chen and Raab, 2017; Yi and Gong, 2013). The agents are defined as follows:

- Service receivers are divided into two types of agents: "interactive and analytical service receivers" and "normal and indifferent service receivers regarding all dimensions of participation.
- Service providers are divided into "active and interactive service providers" and "normal and indifferent service providers regarding all dimensions of collaboration".

 DOI: 10.22067/JSTINP.2025.95251.1175

4.2. Interaction between platform and agents

Platforms are used to enable mutual communication and facilitate interactions between service providers and recipients. So, one can say that for making interaction with agents, platforms should consider the following things (Parker et al. 2016):

- Attraction: Creating a mechanism for attracting service providers and receivers;
- Facilitation: The interactions and communication between service providers and service receivers should be facilitated.
- Adaptation: Using the information about service providers and receivers, make a useful adapting relationship between them.

4.3. Interaction between agents

Here, considering the four types of service providers and receivers defined by collaborative behavior, the relationships among the four agents are described.

- For the interaction between service providers and each other, as well as between service providers and receivers (positive/negative), favorable effects are taken into consideration.
- For the interaction between the service providers and service receivers, positive and negative effects of Opposing nature are taken into consideration.

4.4. Formulating scenarios

The Taguchi experiment design method and Qualitek software (used for Taguchi experimental design) were used for formulating scenarios. So, the final four indicators of platform business development via using open innovation were determined through deep and extensive study on theoretical foundations and research background to be Absorptive capacity, Networking and network management capacity, knowledge and technical capacity, and collaborative capability (Van Lancker et al., 2019; Lyu et al., 2019; Ibrahimov, 2018; De Oliveira et al., 2017; Cheng et al., 2016; Michelini et al., 2015; Brunswicker and Ehrenmann, 2013; Mu and Di Benedetto, 2012; Chesbrough, 2006). Considering the opinion of experts, four levels (Level 1 between 0 and 0.25, Level 2 between 0.25 and 0.50, Level 3 between 0.50 and 0.75, and Level 4 between 0.75 and 1) were determined for every indicator. The study, therefore, has four indicators with four levels for the design of Taguchi experiments. They were then entered into Qualitek software. Table 1 presents the final output of this step: the scenarios developed by the Taguchi experimental design method, comprising sixteen scenarios.

Table 1. The results of the design of Taguchi L16

Collaborative capability	Knowledge and technical capacity	Networking and network management capacity	Absorptive capacity	Scenario
0-0.25	0-0.25	0-0.25	0-0.25	1
0.25-0.50	0.25-0.50	0.25-0.50	0-0.25	2
0.50-0.75	0.50-0.75	0.50-0.75	0-0.25	3
0.75-1	0.75-1	0.75-1	0-0.25	4
0.50-0.75	0.25-0.50	0-0.25	0.25-0.50	5
0.75-1	0-0.25	0.25-0.50	0.25-0.50	6
0-0.25	0.75-1	0.50-0.75	0.25-0.50	7
0.25-0.50	0.50-0.75	0.75-1	0.25-0.50	8
0.75-1	0.50-0.75	0-0.25	0.25-0.50	9
0.50-0.75	0.75-1	0.25-0.50	0.25-0.50	10
0.25-0.50	0-0.25	0.50-0.75	0.25-0.50	11
0-0.25	0.25-0.50	0.75-1	0.25-0.50	12
0.25-0.50	0.75-1	0-0.25	0.75-1	13
0-0.25	0.50-0.75	0.25-0.50	0.75-1	14
0.75-1	0.25-0.50	0.50-0.75	0.75-1	15
0.50-0.75	0-0.25	0.75-1	0.75-1	16

As the significance of each of the platform development indicators using open innovation is different from the other one, a researcher-made questionnaire was made considering the scenarios. The questionnaires were distributed among twelve members of the expert community. The collected data were summed, defuzzified using the center-of-gravity method, and entered into Qualitek software. Variance analysis was performed, and the percentage of participation for each development indicator on the platform was determined. Finally, using the normalization method (introduced by Saaty), the importance level of each indicator was determined. Table 2 presents the weights of each indicator.

Table 2. The normalized weight of the indicators of platform development

Significance	Platform development indicators using open innovation
25.65	Absorptive capacity
22.2	Networking and network management capacity
44.95	Knowledge and technical capacity
7.2	Collaborative capability

Table 2 shows that “knowledge and technical capacity” is 44.95% important, “Absorptive capacity” is 25.65% important, “Networking and network management capacity” is 22.2% important, and “participatory capability” is 7.2% important.

4.5. Designing the conceptual model of research

Based on the explicit assumptions and the reviewed literature, a conceptual model was developed to explain the model's structure and implementation stages. Figure 2 shows the conceptual model.

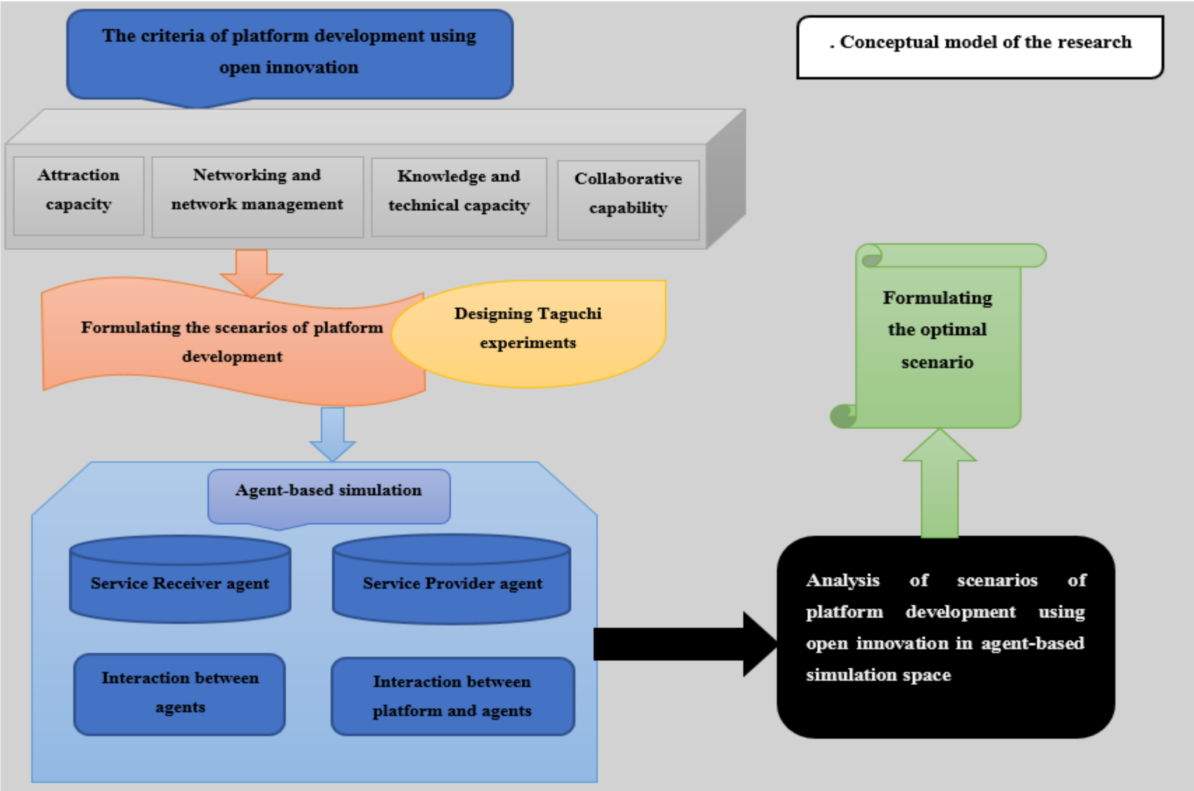

Figure 2. Conceptual model of the research

4.6. Implementing the conceptual model in the AnyLogic software

The conceptual model of this research was implemented in AnyLogic software. The unique feature of this model is its high flexibility. The modeling environment of this research is a platform, and the agents are two service providers (active and interactive; normal and indifferent across all dimensions of participation) and two service receivers (interactive and analytical; normal and indifferent across all dimensions of participation). Several factors were considered for each agent. In the next step, since the agents in the agent-based model interact and communicate with other agents and the surrounding environment, the behavior of each agent was defined in the form of a state chart. Figure 3 shows the state charts for agents that provide and receive services.

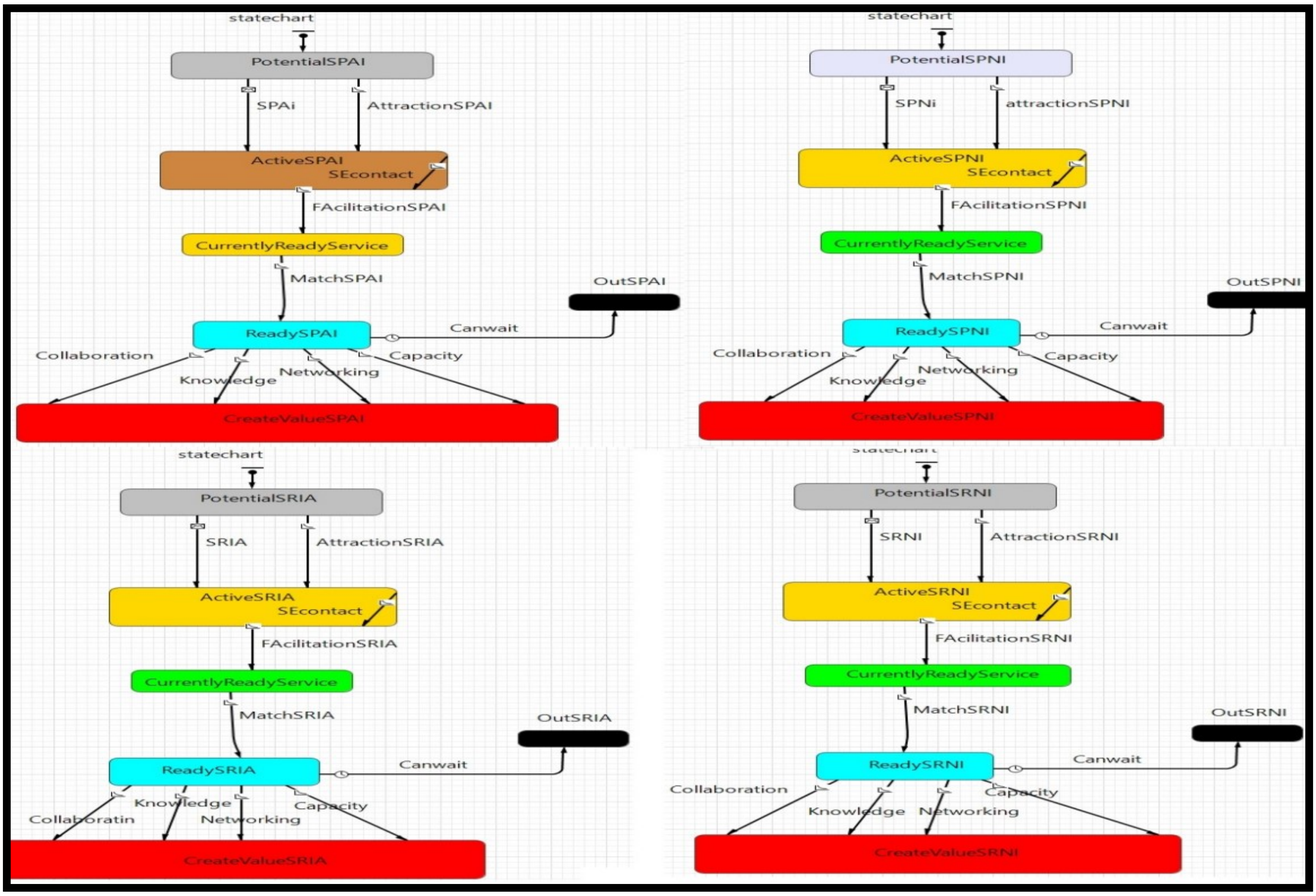

Figure 3. State chart of service provider and service receiver agents

Just before running the model and examining scenarios, the necessary settings were configured using the software's analytical tools, so the agent-based model was prepared for implementation. During the execution stage, the conditions are considered, and each scenario is investigated. After executing each of the sixteen scenarios formulated in AnyLogic and analyzing the results, the output is presented in a table. Table 3 shows the effectiveness of the scenarios.

Table 3. The effectiveness of scenarios

Percentage of created value				**Scenarios of platform development**
Normal and indifferent service providers regarding all dimensions of participation (SPNI)	**Active and interactive service providers (SPAI)**	**Normal and indifferent service receivers regarding all dimensions of participation (SRNI)**	**Interactional and Analytic Service Receivers (SRIA)**	
0.30	0.52	0.31	0.47	1
0.61	0.84	0.59	0.79	2
0.79	0.95	0.77	0.91	3
0.89	0.98	0.87	0.97	4
0.64	0.87	0.61	0.81	5
0.60	0.84	0.56	0.78	6
0.86	0.97	0.85	0.96	7

Percentage of created value				Scenarios of platform development
Normal and indifferent service providers regarding all dimensions of participation (SPNI)	Active and interactive service providers (SPAI)	Normal and indifferent service receivers regarding all dimensions of participation (SRNI)	Interactional and Analytic Service Receivers (SRIA)	
0.85	0.97	0.83	0.94	8
0.80	0.95	0.79	0.93	9
0.87	0.98	0.87	0.97	10
0.70	0.91	0.68	0.85	11
0.81	0.96	0.80	0.93	12
0.87	0.97	0.86	0.97	13
0.83	0.97	0.83	0.95	14
0.84	0.97	0.82	0.95	15
0.80	0.95	0.78	0.93	16

Since Absorptive capacity of the first scenario is 0-0.25, Networking and network management capacity is 0-0.25, knowledge and technical capacity is 0-0.25 and collaborative capability is 0-0.2 is (Table 1, the results of Taguchi experiments design method), at first the average of each interval (the average of the upper limit and the lower limit of each interval) was measured. In the first scenario, the value-Absorptive capacity is 0.125, Networking and network-management capacity is 0.125, knowledge and technical capacity is 0.125, and collaborative capability is 0.125. Because the importance of each item varies and taking into account the results of previous steps (Table 2: normalized weights of platform development indicators), the measured values were multiplied by their respective importance levels. For the first scenario, the values of Absorptive capacity, Networking and network management capacity, knowledge and technical capacity, and collaborative capability are 0.0321, 0.0278, 0.0562, and 0.009, respectively. Here, the values were entered into AnyLogic as model parameters for the first scenario. The output includes the percentage of the created value. The output of the first scenario is 0.52 for active and interactive service providers, 0.30 for normal and indifferent service providers regarding all dimensions of participation, 0.47 for interactive and analytical service receivers, and 0.31 for normal and indifferent service receivers regarding all dimensions of participation. Figure 4 shows the output of the first scenario in AnyLogic. Moreover, the procedure of all other scenarios (16 scenarios) is the same.

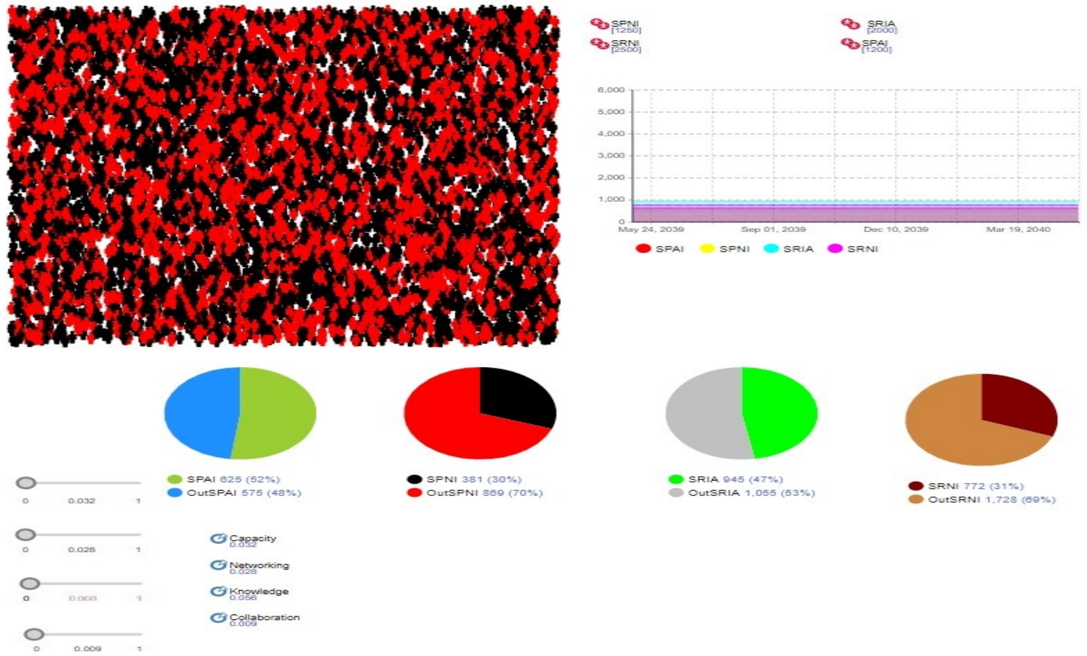

Figure 4. The result of the first scenario

4.7. Formulating the optimal scenarios

The results of formulating the scenarios using the Taguchi method (Table 3, the effectiveness of the scenarios) were analyzed by Qualitek software. Table 4 shows the main impacts of platform development indicators: Absorptive capacity, Networking and network management capacity, knowledge and technical capacity, and collaborative capability for all measured levels.

Table 4. The main impacts of platform development indicators in all levels

LMax – LMin	Level 4	Level 3	Level 2	Level 1	Indicators of platform development using open innovation
2.491	-1.055	-1.405	-2.099	-3.546	Absorptive capacity
2.384	-1.073	-1.417	-2.157	-3.457	Networking and network management capacity
3.205	-0.773	-1.205	-2.148	-3.978	Knowledge and technical capacity
1.324	-1.647	-1.641	-1.851	-2.965	Collaborative capability

Table 4 shows that the optimal level for every indicator of platform development using open innovation is the one in which the main effects are greater. So, the optimal level for the agents of platform development was identified. Table 5 shows the optimal scenario.

Table 5. The optimal scenario

Collaborative capability	**Knowledge and technical capacity**	**Networking and network management capacity**	**Absorptive capacity**	Factors of platform development
Level 3	Level 4	Level 4	Level 4	**The optimal level**
0.5-0.75	0.75-1	0.75-1	0.75-1	

Table 5 shows that in the optimal scenario, the Absorptive capacity is at the fourth level (0.75-1), Networking and network management capacity is at the fourth level (0.75-1), knowledge and technical capacity is at the fourth level (0.75-1), and collaborative capability is at the third level (0.5-0.75). It is worth noting that the optimal scenario obtained at this stage is not among the sixteen scenarios formulated. Here, the optimal scenario is entered into the model in AnyLogic to ensure model validity. In the designed model, the value of each tool of platform development that is 0.2244 for Absorptive capacity, 0.1943 for Networking and network management capacity, 0.3933 for knowledge and technical capacity, and 0.045 for collaborative capability was entered into AnyLogic software. Figure 5 and Table 6 present the model outputs.

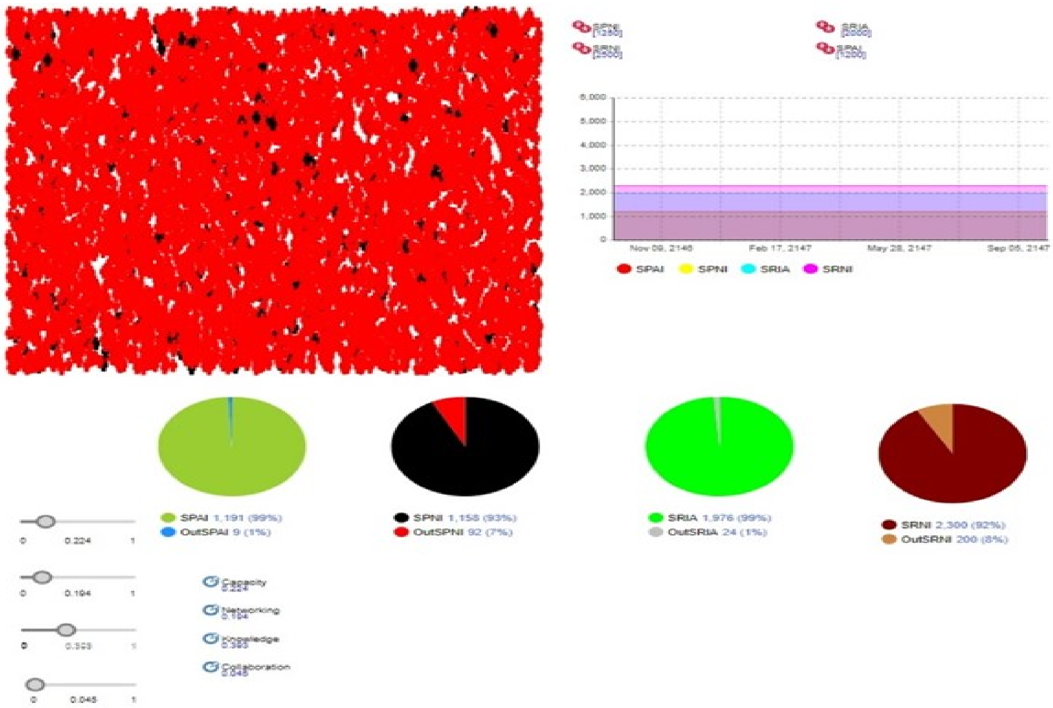

Figure 5. The results of the optimal scenario

Table 6. The effectiveness value of the optimal scenario

Percentage of created value				Scenarios of platform development
Normal and indifferent service receivers regarding all dimensions of participation	**Interactive and analytical service receivers**	**Normal and indifferent service providers regarding all dimensions of participation**	**Active and interactive service provider**	
0.92	0.99	0.93	0.99	**Optimal scenario**

Table 6 shows that in the optimal scenario, the created value for active and interactive service providers is 0.99, the value for normal and indifferent service providers regarding all dimensions of participation is 0.93, the value is 0.99 for interactive and analytical service receivers, and it is 0.99 for normal and indifferent receivers regarding all dimensions of participation. Moreover, the comparison results of the implementation of the optimal scenario show that the percentage of created value is 0.957 for the implementation of the optimal scenario.

5. Discussion and conclusion

Using an agent-based simulation approach, platform development scenarios using open innovation were analyzed. First, the agents, the environment, the interaction between the platform and the agents, and the interaction among the agents were defined; programming in AnyLogic was then implemented, and the model was designed. The simulation and analysis of scenarios based on open innovation indicators were done using Taguchi experiments design method and Qualitek software (in line with Tian and Qiao, 2014). The output of each scenario is the percentage of created value for interactive and analytical receivers, normal and indifferent service receivers across all dimensions of participation, and active and interactive service providers, as well as normal and indifferent service providers, across all dimensions of participation. Finally, to formulate the optimal scenario, the results of scenario implementation in the simulation environment were analyzed using Qualitek software. It appeared that the optimal level of platform development indicators using open innovation for Absorptive capacity is the fourth level that will enhance the ability of platform businesses in understanding the value of external information, attracting, and apply the. It will also make opportunities for innovation. That is, it decreases the limitations of the internal combination of knowledge resources in the innovation model. Absorptive capacity is a dynamic capability (Zahra and George, 2002) and a key structure in innovation management (Cohen and Levinthal, 1989), and a significant factor for competition. Hafkesbrink and Schroll (2010) believe that Absorptive capacity consists of such steps as identifying opportunities, extracting and mixing, understanding and sharing, publishing and applying.

Networking and network management capacity is the fourth level. It Refers to the ability of businesses to create, manage, and optimally apply network connections to leverage the benefits of business networks. It is a fundamental approach to solving problems, to developing platforms (Aarikka-Stenroos et al., 2014), and to tackling resource limitations and creating new opportunities (McGrath et al., 2019). Moreover, some studies (e.g., Fang et al., 2014) have approved the impact of networking on the success of innovation.

Knowledge and technical capacity are the fourth level. It Refers to the systematic process of understanding, accepting, and implementation ability of a business for the better use of knowledge in achieving development and creating a sustainable competitive advantage. The findings of studies such as Chen et al. (2014) and Ning et al. (2006) confirm the issue. One can say that this capacity is dynamic and so significant for developing innovative performance. Moreover, to improve the capacity, the necessary hardware and software mechanisms should be designed, and other issues like management information systems should be established, the creation of a knowledge management system should be created, and domestic databases should be developed.

Collaborative capability is at the third level. It Refers to the ability to collaborate from inside to outside and from outside to inside, as well as to the participation of service providers and recipients in the fundamental paradigms of development. Some studies, such as Hafkesbrink and Schroll (2010) and Jacobfeuerbron (2014), mention the indicator. Moreover, collaborative capability is viewed to be the ability of integrating and leveraging the organizational factors to create capability and capacity, and the aim is to enhance interdisciplinary knowledge exchanges within structural boundaries and then develop side interactions between knowledge-functional components for boosting knowledge flows within the boundaries of an organization.

It should be noted that the optimal scenario in this study is not among the sixteen designed scenarios. The selected scenario was entered into the AnyLogic simulation model, and the output (including the percentage of values generated by each agent) was computed. The created value obtained by implementing the optimal scenario is 0.957.

This study explored key indicators of platform development through open innovation using scenario-based simulation. The simulation results revealed that the optimal levels for Absorptive capacity, networking and network management, and knowledge and technical capacity correspond to the fourth level, whereas collaborative capability achieves optimal performance at the third level. Implementing the optimal scenario increased the overall platform value to 0.957, indicating the effectiveness of the proposed agent-based model in enhancing platform growth. These findings can be explained by the interactions among agents and between agents and the platform. High Absorptive capacity enhances user engagement, while effective networking and network management improve knowledge sharing and collaboration. The moderate level of collaborative capability suggests that excessive coordination may not always yield additional benefits, highlighting the importance of balanced agent interactions. The results have both theoretical and practical implications. Theoretically, they demonstrate that open innovation mechanisms, when integrated into an agent-based model, can dynamically influence platform development. In practice, the findings provide managers with actionable insights for designing and implementing strategies to optimize platform performance. Furthermore, the indicators and scenarios identified in this study can serve as a reference framework for future research in platform business development using alternative methods.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Aarikka-Stenroos, L., Sandberg, B. and Lehtimaki, T., 2014. Networks for the commercialization of innovations: A review of how divergent network actors contribute. *Industrial marketing management*,*43*(3), pp.365-381. https://doi.org/10.1016/j.indmarman.2013.12.005.

Aloisi, A., 2016. Commoditized workers case study research on labor law issues arising from a set of on-demand/Gig economy platforms. *Comparative labor law and policy journal*, *37*(3), pp.653-690. https://doi.org/10.2139/ssrn.2637485.

Alstyne, M. W. and Parker, G.G., 2017. Platform Business: From Resources to Relationships. *NIM Marketing Intelligence Review*, *9*(1), pp.24-29. https://doi.org/10.1515/gfkmir-2017-0004.

Barlatier, P. J., Josserand, E., Hohberger, J. and Mention, A. L., 2023. Configurations of social media-enabled strategies for open innovation, firm performance, and their barriers to adoption. *Journal of Product Innovation Management*, *40*(1), pp.30-57. https://doi.org/10.1111/jpim.12647.

Bigliardi, B., Ivo Dormio, A. and Galati, F., 2012. The adoption of open innovation within the telecommunication industry. *European journal of innovation management*, *15*(1), pp.27-54. https://doi.org/10.1108/14601061211192825.

Billari, F. C., 2015. Integrating macro and micro level approaches in the explanation of population change, *population studies*, *69*(S1), pp.S11-S20. https://doi.org/10.1080/00324728.2015.1009712.

Brailsford, S. C., Eldabi, T., Kunc, M., Mustafee, N. and Osoro, F. A., 2018. Hybrid simulation modeling in operational research: a state-of-the-art review. *European Journal of operational research*, *278*(3), pp.721-737. https://doi.org/10.1016/j.ejor.2018.10.025.

Brunswicker, S. and F. Ehrenmann, F., 2013. Managing open innovation in SMEs: A good practice example of a German software firm. *International Journal of Industrial Engineering and Management*, *4*(1), pp.33-41. https://doi.org/10.24867/IJIEM-2013-1-105.

Čeh, I., Štorga, M. and Delač, G., 2022. Agent-based modelling: Parallel and distributed simulation of product development team. *Tehnički vjesnik*, *29*(4), pp.1424–1432. https://doi.org/10.17559/TV-20200922160617.

Chen, H. H., Qiao, S. and Lee, A. H. I., 2014. The impacts of differentR&D organizational structure on performance of firms: perspective of absorptive capacity. *The journal of High Technology management research*, *25*(1), pp.83-95. https://doi.org/10.1016/j.hitech.2013.12.007.

Chen, S. C. and Raab, C., 2017. Construction and Validation of the Customer Participation Scale. *Journal of Hospitality and Tourism Research*, *41*(2), pp.131–153. https://doi.org/10.1177/1096348014525631.

Cheng, C. C., Yang, C. and Sheu, C., 2016. Effect of open innovation and knowledge-based dynamic capabilities on radical innovation: An empirical study. *Journal of engineering and technology management*, *41*, pp.79-91. https://doi.org/10.1016/j.jengtecman.2016.07.002.

Cheng, C. C.J. and Shiu, E. C., 2015. The inconvenient truth of the relationship between open innovation activities and innovation performance. *Management Decision*, *53*(3), pp.625-647. https://doi.org/10.1108/MD-03-2014-0163.

Chesbrough H., 2006. Open innovation: A new paradigm for understanding industrial innovation. *Oxford University Press*, pp.1-12. https://doi.org/10.1093/oso/9780199290727.003.0001.

Chesbrough, H., 2017. The Future of open innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants. *Research Technology management*, *60*(1), pp.35-38. https://doi.org/10.1080/08956308.2017.1255054.

Cohen, W. M. and Levinthal, D. A., 1989. Innovation and learning: the two faces ofR&D. *The economic journal*, *99*(397), pp.569-596. https://doi.org/10.2307/2233763.

Crooks, A. T. and Heppenstall, A. J., 2012. Introduction to agent-based modelling *Agent-based models of geographical systems* (pp. 85-105): Springer.

Crooks, A. T., Heppenstall, A. and Malleson, N., 2017. *Agent-based modeling*, in Huang, B. (ed), Comprehensive Geographic Information Systems, Elsevier, Oxford, England. 1, pp.218-243. https://doi.org/10.1016/B978-0-12-409548-9.09704-9.

De Oliveria, L. S., Echeveste, M. E. S., Cortimiglia, M. N. and Goncalves, C. G. C., 2017. Analysis of determinants for open innovation implementation in regional innovation systems. *Innovation and Management Review*, *14*(2), pp.119-129. https://doi.org/10.1016/j.rai.2017.03.006.

do Prado, G. F., de Souza, J. T. and Piekarski, C. M., 2025. Sustainable and Innovative: How Can Open Innovation Enhance Sustainability Practices? *Sustainability*, *17*(2), p.454. https://doi.org/10.3390/su17020454.

Eisenmann, T., Parker, G. and Alstyne M. V., 2011. Platform envelopment. *Strategic management journal*, *32*(12), pp.1270-1285. https://doi.org/10.1002/smj.935.

Epstein, J. M. and Axtell, R., 1996. *Growing artificial societies: Social Science from the bottom Up*. 1th Edition, Cambridge, MA: The MIT Press. https://doi.org/10.7551/mitpress/3374.001.0001.

Fang, G., Ma, X. Y., Brouwers-Ren, L. and Zhou, Q., 2014. Antecedents of network capability and their effects on innovation performance: An empirical test of hi-tech firms in china. *Creativity and innovation management*, *23*(4), pp.436-452. https://doi.org/10.1111/caim.12083.

Gawer, A. and Cusumano, M. A., 2014. Industry platforms and ecosystem innovation. *Journal of product innovation management*, *31*(3), pp.417-433. https://doi.org/10.1111/jpim.12105.

Golembiewski, R., 2017. *Organization development: Ideas and issues*. Routledge, New York. https://doi.org/10.4324/9781315125886.

Hafkesbrink, J. and Schroll, M., 2010. *Organizational Competences for Open Innovation in Small and Medium Sized Enterprises of the Digital Economy*. innowise GmbH, Bürgerstr. 15, 47057 Duisburg, Germany.

Hagiu, A. and Wright, J., 2015. Multi-sided platforms. *International journal of industrial organization*, *43*. pp.162-174. https://doi.org/10.1016/j.ijindorg.2015.03.003.

Henkel, J., 2006. Selective revealing in open innovation processes: the case of embedded Linux. *Research policy*, *35*(7), pp.953-969. https://doi.org/10.1016/j.respol.2006.04.010.

Huizingh, E. K.R.E., 2011. Open innovation: state of the art and future perspectives. *Technovation*, *31*(1), pp.2-9. https://doi.org/10.1016/j.technovation.2010.10.002.

Huotari, P. and Ritala, P., 2017. Complementor strategy and platform performance. *Academy of Management Proceedings*, *1*, p.11670. https://doi.org/10.5465/AMBPP.2017.11670abstract.

Ibrahimov, B., 2018. Open innovation and application to petroleum industry. *IFAC Papers Online*, *51*(30), pp.679-702. https://doi.org/10.1016/j.ifacol.2018.11.212.

Jacobfeuerbron, B., 2014. An information model of open innovation. Intelligent tools for building a scientific information platform: from research to implementation. *Studies in computational intelligence*, *541*, pp.15-24. https://doi.org/10.1007/978-3-319-04714-0_2.

Jagstedt, S. and Persson, M., 2019. Using Platform strategies in the development of integrated product service solutions. *International journal of innovation management*, *23*(4), pp.1-36. https://doi.org/10.1142/9781786347602_0011.

Jovanovic, M., Sjödin, D. and Parida, V., 2022. Co-evolution of platform architecture, Platform service, and platform governance: expanding the platform value of industrial digital platforms. *Technovation*, *118*, p.102218. https://doi.org/10.1016/j.technovation.2020.102218.

Keller, P., 2004. *Six sigma demystified: A self-teaching guide*. McGraw-Hill Companies, New York, NY. https://doi.org/10.1036/0071469540.

Li, H., Zhang, G., Liu, H. and Feng, J., 2025. Cloud Platform Business Scenario Modeling Based on Multi-Model Fusion Recommendation Algorithm. *International Journal of High-Speed Electronics and Systems*, *34*(01), p.2540083. https://doi.org/10.1142/S012915642540083X.

Lyu, Y., He, B., Zhu, Y. and Li, L., 2019. Network embeddedness and inbound open innovation practice. The moderating role of technology cluster. *Technological Forecasting and Social Change, Elsevier*, *144*, pp.12-24. https://doi.org/10.1016/j.techfore.2019.03.018.

Mady, K., Anwar, I., Boomage, M. and Sulub, M. A.,2025. Digital entrepreneurial platform capability: instrument development and validation, and its impact on entrepreneurial performance. *Technology in Society*, p.102886.https://doi.org/10.1016/j.techsoc.2025.102886.

Manhães, V., Vazquez, M. and Urraca, A., 2025. Innovation and the Evolution of Market Structure in Complex Industries: An Agent-Based Model Simulation in the Internet Industry. *Journal of Knowledge Economics*. Advance online publication. https://doi.org/10.1007/s13132-024-02557-w.

McGrath, H., Medlin, C. J. and O Toole, T., 2019. A process-based model of network capability development by a start-up firm. *Industrial marketing management*, *80*, pp.214-227. https://doi.org/10.1016/j.indmarman.2017.11.011.

Meijerink, J. and Keegan, A., 2019. Conceptualizing human resource management in the gig economy: Toward a platform ecosystem perspective. *Journal of Managerial Psychology*, *34*(4), pp.214-232. https://doi.org/10.1108/JMP-07-2018-0277.

Mu, J. and Di Benedetto, A., 2012. Networking capability and new product development. IEEE *Transactions on engineering management*, *59*(1), pp.4-19. https://doi.org/10.1109/TEM.2011.2146256.

Nagy, N., Bläse, R., Filser, M., Appenzeller, J. and Puumalainen, K., 2025. Platform dynamics and rapid scaling: An empirical examination of growth drivers in platform-based start-ups. *Review of Managerial Science. Advance online publication*. Advance online publication. https://doi.org/10.1007/s11846-025-00918-6.

Ning, Y., Fan, Z.-P. and Feng, B., 2006. Knowledge capability: A definition and research model. *In Proceedings of the First International Conference on Knowledge Science, Engineering and Management* (KSEM 2006),pp. 330–340.

Obradović, T.; Vlačić, B.; Dabić, M., 2021. Open innovation in the manufacturing industry: A review and research agenda. *Technovation*, *102*, p.102221. https://doi.org/10.1016/j.technovation.2021.102221.

Parker, G., Van Alstyne, M. W. and Choudary, P. C., 2016. *Platform Revolution*: *How networked markets are transforming the economyand how to make them work for you*. New York: W. W. Norton & Company.

Pykäläinen, T., 2007. Model for profiting from software innovations in the new era in computing. *Tecnovation*, *27*(4), pp.179-193. https://doi.org/10.1016/j.technovation.2006.11.005.

Raco, J. R., Raton, Y., Tumewu, T. W., Raco, B. and Widjaja, I., 2024. Strategic Development of Online Business Platform Using AHP and QFD: A Case Study of Manado City, Indonesia. *Futurity Economics and Law*, *4*(1), pp.64-86. https://doi.org/10.57125/FEL.2024.03.25.05.

Rochet, J. C. and Tirole, J., 2003. Platform competition in two-sided markets. *journal of the European economic association*, *1*(4), pp.990-1029. https://doi.org/10.1162/154247603322493212.

Rodríguez-Arias, A., Sánchez-Maroño, N., Guijarro-Berdiñas, B., Alonso-Betanzos, A., Lema-Blanco, I. and Dumitru, A., 2025. An agent-based model to simulate the public acceptability of social innovations. *Expert Systems*, *42*(2), e13731. https://doi.org/ 10.1111/exsy.13731.

Sá, T., Ferreira, J.J.M. and Jayantilal, S. 2025. Open innovation strategy: a systematic literature review. *European Journal of Innovation Management*, *28*(2), pp. 454-510. https://doi.org/10.1108/EJIM-11-2022-0638.

Sawhney, A., Bashford, H., Walsh, K. and Mulky, A. R., 2003. Agent based modeling and simulation in construction. Proceedings of the 2003 Winter Simulation Conference. IEEE, New Orleans, LA, USA. https://doi.org/10.1109/WSC.2003.1261600.

Schwab, S., Koch, J., Flachskampf, P. and Isenhardt, I. 2011. Strategic implementation of open innovation methods in small and medium-sized enterprises. 17th International conference on concurrent enterprising, Aachen, Germany, pp.1-8. https://doi.org/10.1007/978-3-642-33389-7_12.

Silverman, E., Bijak, J., Hilton, J., Cao, V. D. and Noble, J. 2013. When demography met social simulation: a tale of two modeling approaches. *Journal of artificial societies and social simulation*, *16*(4), pp.1-9. https://doi.org/10.18564/jasss.2327.

Skold, M. and Karlsson, C. 2012. Product platform replacements: challenges to managers. *International journal of operations and production management*, *32*(6), pp.746-766. https://doi.org/10.1108/01443571211230952.

Stummer, C., 2024. *Agent-based modelling in innovation management*. In F. Wall, S.–H. Chen, and S. Leitner (Eds.), *The Oxford Handbook of Agent-based Computational Management Science* (online edn). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197668122.013.7.

Taylor, S., 2014. *Agent-based Modeling and Simulation*, The OR Essentials series Series Standing Order, Brunel University, UK.

Tian, G. and Qiao, Z., 2014. Modeling urban expansion policy scenarios using an agent- based approach for Guangzhou Metropolitan Region of China. *Ecology and Society*, *19*(3), p.52. https://doi.org/10.5751/ES-06909-190352.

Topalova, I., Lozova, T., Riepnova, T., Dashchenko, N., Chudaieva, I. and Darushyn, O., 2024. Business Process Management in Entrepreneurial Activity Based on a Platform Approach. *Indian Journal of Information Sources and Services*, *14*(2), pp.46-55. https://doi.org/10.51983/ijiss-2024.14.2.08.

Van Lancker, J., Wauters, E. and Van Huylenbroeck, G., 2019. Open innovation in public research institutes-Success and influencing factors. *International Journal of Innovation Management*, *23*(7), pp.1-37. https://doi.org/10.1142/S1363919619500646.

Virlee J. Hammedi W. and Parida V., 2015. Open Innovation Implementation the service industry: Exploring practices, Sub- practices and contextual Factors. *Journal of innovation management*, *3*(2), pp.106-130. https://doi.org/10.24840/2183-0606_003.002_0009.

Wan, X., Cenamor, J., Parker, G. and Van Alstyne, M., 2017. Unraveling platform strategies: A review from an organizational ambidexterity perspective. *Sustainability*, *9*(5), p.734. https://doi.org/10.3390/su9050734.

West, J., Gallagher, S., 2006. Challenges of open innovation: the paradox of firm investment in open-source software.R&D *management*, *36*(3), pp.319-331. https://doi.org/10.1111/j.1467-9310.2006.00436.x.

Yablonsky, S. 2018. A multidimensional framework for digital platform innovation and management: from business to technological platforms. *Systems research and behavioral science*, *35*(4), pp.485-501. https://doi.org/10.1002/sres.2544.

Yi, Y. and Gong, T. 2013. Customer Value Co-Creation Behavior: Scale Development and Validation. *Journal of Business Research*, *66*(9), pp.1279-1284. https://doi.org/10.1016/j.jbusres.2012.02.026.

Zahra, S. A. and George, G., 2002. Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), pp.185-203. https://doi.org/10.2307/4134351.