

PAPER • OPEN ACCESS

Analysis daily newspaper distribution in Solo by Agent Based Simulation

To cite this article: Izatul Fitria Febriandini *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **528** 012033

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the **collection** - download the first chapter of every title for free.

Analysis daily newspaper distribution in Solo by Agent Based Simulation

Izatul Fitria Febriandini¹⁾, Yuniaristanto²⁾, Wahyudi Sutopo³⁾, Muhammad Hisjam⁴⁾

¹⁾ Laboratory Assistant Logistics Systems and Business, Industrial Engineering Department
Sebelas Maret University, Indonesia

^{2,3,4)} Research Group of Industrial Engineering and Techno Economic, Industrial Engineering
Department, Sebelas Maret University, Indonesia

Abstract. Agent based simulation is a simulation model that can be used to describe the interaction between the involved agents. The interaction is generated from observations of human behavior. This study aims to provide an overview of business process PT Aksara Solopos and involved agents in it, especially for Koran Harian Solopos. In addition, to cope with the large number of paper returns is estimating the newspaper demand by simulation. Simulations done using NetLogo 6.0.3 applications. This research produced the number of clients who are subscribed by newspaper deliveryman and daily stock for the company, newsagents, newspaper deliveryman to complete the consumer demand.

Key Words: Agent Based Simulation, Daily Stock Newspaper, NetLogo

1. Introduction

Various industries have been affected by the development of technology especially in the area of information, and communication. One of those industries that affected by technology is newspaper industry. As the reader of newspaper is switching to digital based newspaper, the demand for printed newspaper become decreased. With the decreasing demand and many readers has switched to digital based newspaper, the evaluation for newspaper production need to be reassessed in order to adapt with the market condition.

Many simulation research have been done every year, such as :

Table 1. Previous research

No	Author	Content
1	Marzouk and Daour (2018)	presents a framework that aids contractors and safety managers in planning labor evacuation for construction sites using Building Information Modelling (BIM) and computer simulation using Agent-Based Simulation
2	Makinde, et.al. (2019)	Developed an agent-based model of a particular passenger rail system using an activity based simulation approach to predict the impact of public transport demand management pricing strategies.
3	Dong, et. al. (2019)	Simulating and optimizing Traffic Signal Control for real-time control system is investigated recently with development by the Internet of things (IoT)



4	Cloutier and Yang (2108)	Examines the robustness of three methods of GFO in the presence of variability in the contact locations and in the coefficients of friction between the hand and the object. A Monte Carlo simulation is used to determine the resulting probability of failure and sensitivity levels when variability is introduced
5	Vossos, et.al. (2018)	Monte Carlo simulation is used to compute the payback period and lifecycle cost savings of DC versus AC distribution systems. A future-market scenario is also examined, which evaluates how future efficiency improvements in power converters and changes in electricity tariffs may affect cost savings.

Agent-based simulation considers the interactions between the participating entities in detail, incurring substantial computational load. The agent state is represented by a set of variables associated with each agent (Yang, 2018). Agent-based simulation is an approach for simulation that also uses the notion of agents and the purpose of ABS compared to multi-agent systems is to gain insight into how global properties emerge from a system of local interacting processes (Larsen, 2018)

The decision to buy is a function of how close the expectations of the buyer on a product by the buyer on the perceived performance of the product (Oktina, 2002). This is one of the marketing strategy, by knowing the buyer and try to realize their need in products. Therefore companies need to assess whether the intended target market for this is correct or need to be evaluated to increase the amount of Koran Harian Solopos sales.

However, with the advent of digitalization era at this time, it could decrease Koran Harian Solopos sales and increase the newspaper return. To reduce the rate of return of newspapers, optimal stock of daily newspaper to complete the demand of customers every day have to be determined. So we need a simulation to forecast the demand of newspapers in Solo. Forecasting usually uses historical data (past data), but if forecasting doing with simulation, it can be done without using historical data (Zutshi, 2017)

Issues raised in the present study is an assessment of the extent to which the effectiveness of the distribution of Koran Harian Solopos in Solo. Based on the problems, explained into research objectives, such as:

- Identifying agents involved in the distribution process of Koran Harian Solopos.
- Identifying the amount of daily stock newspapers on the amount of a particular consumer.
- Identifying the factors that influence the behavior patterns of interaction performed by the agents involved in the business process of Solopos.

Limitation of problems used in this study are:

- Brands newspaper only used Koran Harian Solopos, which contains local news in Surakarta.
- Newspaper distribution area is Solo only.

2. Method

The assessment of the interaction between the involved agents starts from literature review that related to the issues of distribution of products in general. The next stages are collection and processing the data. The data collected comes from interviews some of the involved agents, and secondary data obtained from the literature review.

Processing data using Agent-Based Simulation, which uses a model to describe the events that actually occur. From the processing data, do conclusion and give advice to support future research.

Pseudocode to describe the agent are :

```

breed [factories factory]
breed [distributors distributor]
breed [retailers retailer]
breed [customers customer]

```

Figure 1. The pseudocode to defining agents

Pseudocode to describe the demand stock are :

Factories-own [	distributors-own [	retailers-own [	customers-own [
production_rate	EOQ	EOQ	next_review
reorder_point	next_review	next_review	daily
orders	reorder_point	reorder_point	suppliers
available_stock	orders	suppliers	supplier_score
clients	available_stock	supplier_score	supplier0
daily_sales	suppliers	supplier0	clients
sales	supplier_score	clients	daily_sales
lost_sales	supplier0	daily_sales	lost_sales
forecast	clients	sales	forecast
holding_cost	daily_sales	lost_sales	placed_orders
order_cost	sales	forecast	holding_cost
total_cost	lost_sales	placed_orders	order_cost
]	forecast	total_cost	]
	placed_orders	]	
	holding_cost		
	order_cost		
	total_cost		
	]		

Figure 2. The pseudocode to defining demand

3. Result and Discussion

Data used in this study is the primary data with the instruments are used interviews with the questionnaire. Resource is classified into two types; internal, Solopos sales division, and external companies that newsagents and newspapers deliveryman in the area of Solo.



Figure 3. Map of Solo

Interviewees Solopos internals are sales of its own, namely the Circulation Manager and Marketing Division (sales). Sales are elected as representatives of the company. Interviews were conducted to determine the background of the company, business processes thoroughly PT Aksara Solopos, sales flow of Koran Harian Solopos, and strategy that has been applied by the company to gain new consumers.

External resource are newsagents in Solo marked by yellow in Figure 2. Interviews with agents conducted to gather information related to the demand data of newspapers each day, the number of employee (a newspaper deliveryman), the consumers data who make a special subscription of Koran Hairan Solopos, average number of returned newspaper each month and the factors that influence the increase of sales of Koran Harian Solopos every day. While the interviews conducted by newspapers deliveryman are associated with a number of newspapers carried daily, the average number of newspapers sold each day, the number of consumers who subscribe, how to get a regular consumers, factors affecting sales of the newspaper every day and work hour each day.

Problem happens on a complex system. And complex systems not only have interconnected components, but also have process that is at a certain level which is derived from the interaction of the lower component (Vattam, 2011). Therefore, use a model to facilitate the research process.

Model design with Agent Based Simulation methods are simulated with NetLogo. Agent Based Simulation is a new modeling paradigm that is based on the utility of the agent. Which is entities or individuals interacting (Fuente, 2017).

NetLogo is a multi-agent programming language and environment modeling. A research tool and real-world simulations and complex social phenomena (Hitaswi, 2017). One example of an experiment of social phenomena is to develop research on smart city (Seidita, 2017). Based on this, four agents is used to model individual to resolve the issues raised, the company, newsagent, newspaper deliveryman and consumers.

'Breed' is a code defined for involved agents in the program. While the code 'own' is the code used to indicate the assignment of the involved agents (Pradopo, 2014)

The distribution process of existing newspaper which originated by the company to the newsagent that spread over an area of Solo. The newsagents has a few newspapers deliveryman to spread the newspapers to the final consumer in the form of institutions or individual consumers. Residential or consumers who pass by.

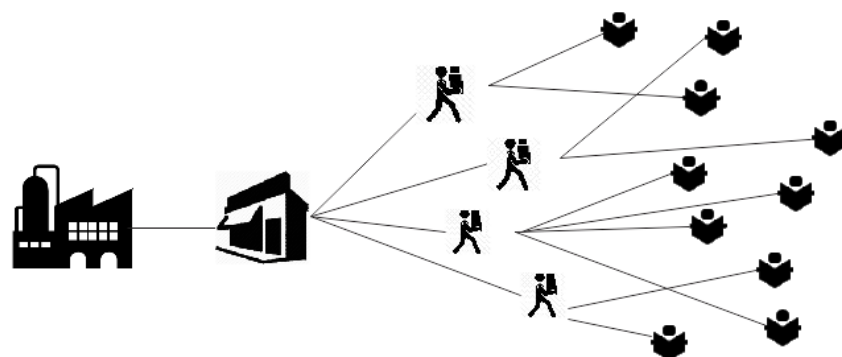


Figure 4. The description of the distribution process of newspapers in Solo

Based on interviews at several involved agents of the sale of Koran Harian Solopos, found that newspaper sales are influenced by several factors. These factors can be grouped into two, namely internal factors and external factors. Internal factors are affected by the activities sourced from within

the company, such as delays in delivery. While external factors are sourced from all activities that have an impact on Solopos business processes, one of them is the news quality (headline). Other factors can be seen from a previous study conducted by Zakaria, et al (2005), regarding the market segment of Koran Harian Solopos that is based on the completeness of news, style, price, ease of obtaining, headline news, current news, and the news factuality.

Agent Based Simulation (AB) selected because AB can produce a complex system behavior, the behavior resulting from the interaction of the simple agents contained inside it (Macal et al, 2010). And according Muscallagiu (2014) agent based modeling is type of modeling that focuses representing agents and their interactions. The computer model used Net Logo 6.0.3.

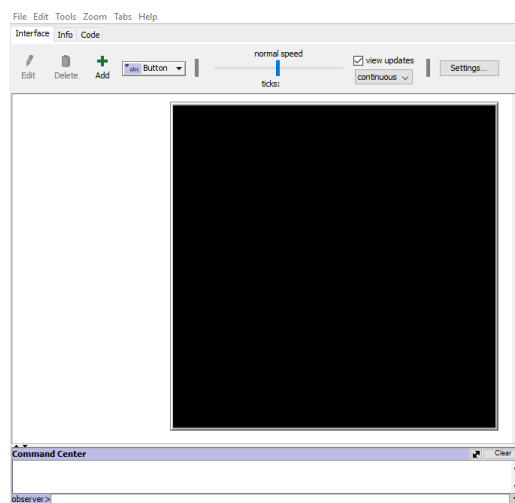


Figure 5. Initial View NetLogo

Users can make the adjustment to the number of companies, the lead time required, the number of newsagents (agen), number deliveryman (loper) and the desired number of consumers (pelanggan) through 4 pieces of the slider as in Figure 6.

Simulations run by making adjustments to all existing slider in accordance with the desired amount. Then press the setup button to erase and reset the program. Furthermore, for running the program, press 'Go' button (for running the program are continuous) or 'Step' button (for running the step by step).



Figure 6. Slider to control the number of involved agents

Figure 7 is the display after NetLogo running the program. When the simulation is running, the location of all agents are assumed to equal (not move). The simulation was performed to determine the daily stock as needed.

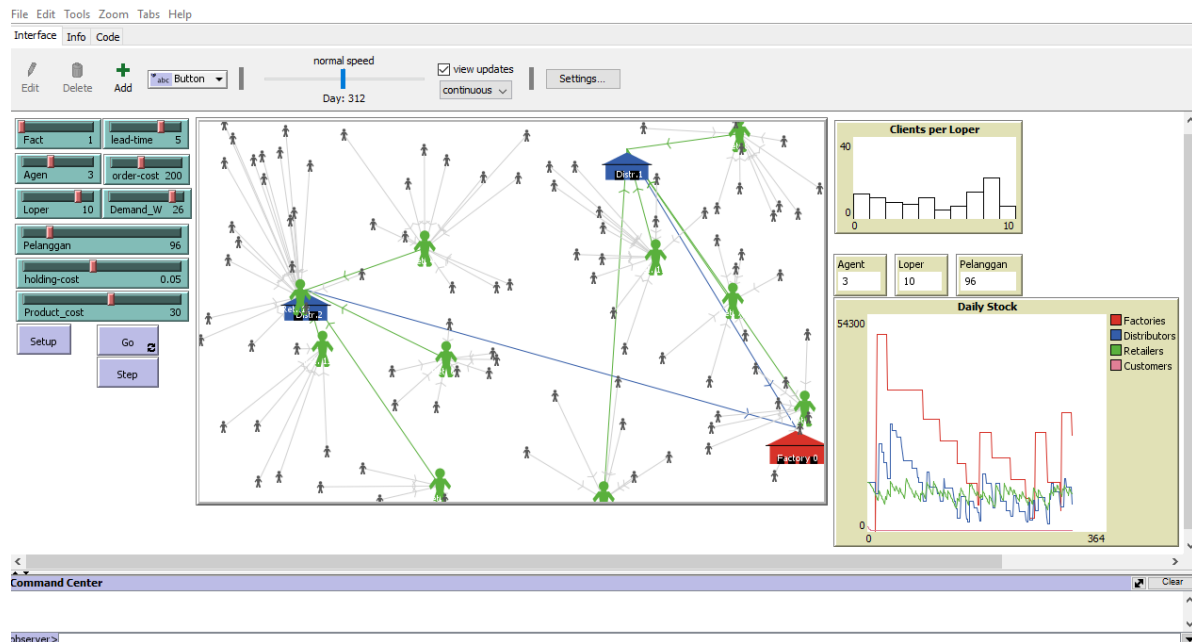


Figure 7. Simulation by NetLogo

Total newsagent in Solo is ± 128 agents. But in the program only simulated 3 newsagent (blue) and 10 newspaper deliveryman (green) and the number of customers are 96 people (grey). So we get the number of clients per deliveryman as follows:

Table 2. Simulation Results for Newspapers Deliveyman

Deliveryman	1	2	3	4	5	6	7	8	9	10
Client per deliveryman	8.1	2.2	3	3.96	4.93	6:08	6.92	7.89	8.94	9.91
Rounding	9	3	3	4	5	7	7	8	9	10

And the result is the number of the daily stock chart. And simulations generated from figure 8 is made during 146 days. From the graph in figure 8, it can be seen that the red color symbolizes the daily stock newspapers that are required by the company, the blue color is symbolizing the daily stock newspapers that are required by the newsagents, that in the simulation have 3 newsagents, and the green is symbolizing the daily stock newspapers that are required by newspapers deliveryman, in the simulation were 10 deliveryman. Newspaper stock levels line for companies should be above the line of the stock paper other agent. If the lines for companies under the line of another agent, it shows that the existing stock of the company could not complete the consumers demand, in this case, namely the newsagent and newspapers deliveryman.

The resulting model enables the visualization of real time metrics. During the processing time (run time) can be used control charts that could be updated in real time (Muscallagiu, 2014). It can be seen in figure 8.

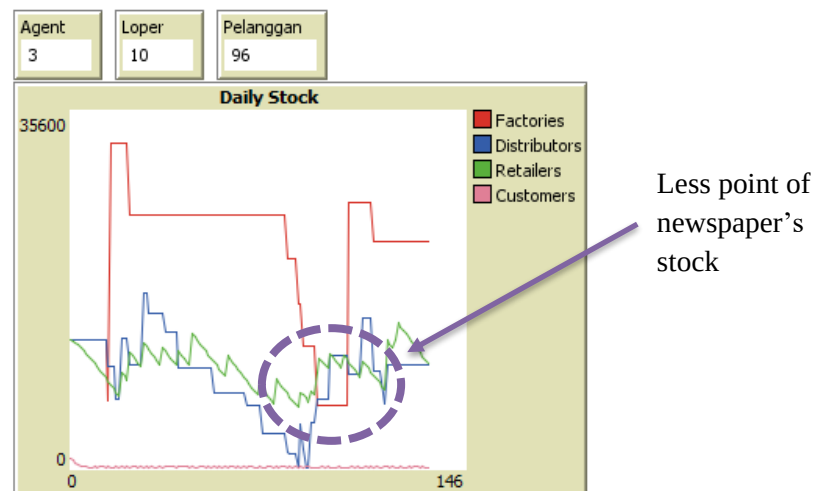


Figure 8. The simulation results of needed daily newspaper's stock

4. Conclusion

Agent Base Simulation is a concept that uses *agent* to determine the interactions made by involved agents. Based on the experimental results, we can conclude that the agent base simulation can be used to model the process of Koran Harian Solopos distribution to consumers in Solo. So we get the results of the output of a number of daily necessary stock of newspaper to complete customer demand with the number of newsagents, the number of deliveryman and the number of consumers can be adjusted. And NetLogo can be used as an application to modeling the simulations of the Koran Harian Solopos distribution. However, it should be underlined that the amount of demand that occurs every day is very volatile, one of them is depends on the quality that news delivered.

4.1 Suggestion

- In this study does not present the optimal amount of the newspaper distribution on any given day. Need the optimization analysis to determine the optimal amount of demand of the newspaper.

Acknowledgments

The research is supported by Institute for Research and Community Service, Sebelas Maret University with Hibah Riset Fundamental UNS (RF-UNS) Research Program (Contract No. 543/UN27.21/PP/2018).

5. References

- [1] Cloutier, A., & Yang, J. (2018). Examining the Robustness of Grasping Force Optimization Methods Using Uncertainty Analysis. *Journal of Risk and Uncertainty in Engineering Systems*, 1-8.
- [2] Dong, H. V., Khanh, B. Q., & Lich, N. T. (2019). Integrating Multi-agent System, Geographic Information System, and Reinforcement Learning to Simulate and Optimize Traffic Signal Control. *Springer International Publishing AG*, 145-154.
- [3] Fuente, D. d., Gomez, A., Ponte, B., & Costas, J. (2017). Agent-Base Prototyping for Business Management: An Example Based on the Newspaper Problem. *Journal of Economics, Business and Management*, 44-49.
- [4] Hitaswi, N., & Chandrasekaran, K. (2017). Agent Based Social Simulation Model and Unique Identification Based Empirical Model for Public Distribution System. *International Conference on Recent Advances in Electronics and Communication Technology* (pp. 234-238). India: IEEE.

- [5] Kerami, D. (n.d.). Konsep Umum Model dan Model Matematis. In *Permodelan Matematis* (pp. 1-41).
- [6] Larsen, J. B. (2018). Agent Programming Languages and Logics in Agent-Based Simulation. *Springer International Publishing AG*, 517-526.
- [7] Macal, C. M., Chan, W. V., & Young-Jun, S. (2010). Agent-Based Simulation Tutorial-Simulation of Emergent Behavior and Differences Between Agent-Based Simulation and Discrete-Event Simulation. *Proceedings of the 2010 Winter Simulation Conference*, (pp. 135-150).
- [8] Makinde, O., Neagu, D., & Gheorghe, M. (2019). Agent Based Micro-simulation of a Passenger Rail System Using Customer Survey Data and an Activity Based Approach. *Springer Nature Switzerland AG*, 123-137.
- [9] Marzouk, M., & Daour, I. A. (2018). Planning labor evacuation for construction sites using BIM and agent-based simulation. *Safety Science*, 174-185.
- [10] Muscallagiu, I., Emil, P. H., & Negru, V. (2014). Enhancing DisCSP-Netlogo from simulation to real-execution of agents in distributed constraints. *18th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems - KES2014* (pp. 261-270). Romania: Elsevier.
- [11] *NetLogo 6.0.4 User Manual*. (n.d.). Retrieved from <http://ccl.northwestern.edu/netlogo>
- [12] Oktina, A. (n.d.). Analisis Hubungan Antara Karakteristik Konsumen dengan Atribut Produk dalam Pengambilan Keputusan Berlangganan Surat Kabar Solopos di Surakarta.
- [13] Pradopo, S. T. (2014, April 18). *Panduan Pemrograman | Tutorial NetLogo*. Retrieved from Earth, Space & Beyond: <http://tripradopo.web.ugm.ac.id>
- [14] Seidita, V., & Chella, A. (2017). Representing social intelligence: An agent-based modeling application. *Biologically Inspired Cognitive Architectures*, 35-43.
- [15] Vattam, S. S., Goel, A. K., & Rugaber, S. (2011). Behavior Patterns: Bridging Conceptual Models and Agent-Based Simulations in Interactive Learning Environments. *11th IEEE International Conference on Advanced Learning Technologies* (pp. 139-141). USA: Computer Science.
- [16] Vossos, V., Gerber, D., Bennani, Y., Brown, R., & Marnay, C. (2018). Techno-economic analysis of DC power distribution in commercial buildings. *Applied Energy*, 663-678.
- [17] Yang, M., Andelfinger, P., Cai, W., & Knoll, A. (2018). Evaluation of Conflict Resolution Methods for Agent-Based Simulations on the GPU. *SIGSIM-PADS*, 129-132.
- [18] Zakaria, R., Fahma, F., & Astuti, E. R. (2005). Perencanaan Strategi Pemasaran (Segmentation, Targeting dan Positioning) Koran Harian Solopos Berdasarkan Persepsi Konsumen. *Performa* (pp. 25-38). Surakarta: IDEC.
- [19] Zutshi, A., Grilo, A., Nodehi, T., Mehrbod, A., & Goncalves, R. J. (2017). Simulation and forecasting of digital pricing models for an e-procurement platform using an agent-based simulation model. *Journal of Simulation*.