

AGENT-BASED MODELING FOR NEW PRODUCT INTRODUCTION USING TWITTER

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Abstract

In less than 4 years since its introductions, Twitter has become the fastest growing social networking tool. Working very much the same as a blog, it has been used widely by businesses as well as individuals to share information, introduce new product/idea, etc. Using Twitter, a person has the choice whether or not to forward (re-tweet) the message from/to his/her friends or social networks that he/she belongs to. There are some factors which affect the decision to re-tweet or not a message, besides the speed in forwarding the messages which believed to follow the Diffusion of Innovations model. In the case of new product introduction using Twitter, an online survey has been conducted to obtain the factors which affect the decision and timing to re-tweet the message or not. On the other hand, the independent and autonomous behavior of members in a social network such as Twitter satisfies the characteristics of Agent Based Simulation model. Using NetLogo software, this paper aims to disclose the result of an Agent Based Simulation model which showed when and why a person will or will not re-tweet a message that he/she received from his/her friends or social networks that he / she belongs to by applying the concept of Diffusion of Innovations.

Keywords: *twitter, social networking, agent based simulation, diffusion of innovation, NetLogo*

1. Introduction

1.1. Description of the social system

Twitter is quickly becoming the fastest growing social networking tool available since it was created by Jack Dorsey in May 2007. It is a part of the new Social Media revolution, a new way that people discover, share and read news and information on the Internet through social networks or micro blogs such as Twitter. It works much the same way as a blog, only with the character limit of 140 for each message sent out, called a "tweet", which is just enough for a quick update.

The concept of Twitter relies on messaging services, whether it uses a cell phone, instant messenger, such as Yahoo Messenger or MSN Messenger, or through specific websites. It allows the user to send messages to friends and family quickly and easily. Businesses found that Twitter is a great place to share information on their companies, converse with prospects and customers and offers a whole new way of advertising. Most businesses now are using Tweeter as an alternative method for new idea / innovation / product introduction, besides the conventional methods. When a new idea / innovation / product is tweeted to a person or a social network, the person who received it may decide whether to send it again (re-tweet) to his / her friends / networks instantly, or sometimes later, or even do nothing at all.

Applying the concept of Diffusion of Innovations introduced by Everett M. Rogers in 1962, a person who decides to re-tweet a message can be grouped into innovators, early adopters, early majority, late majority and laggards. Each person's willingness to re-tweet the message depends on his/her consideration on several factors, such as:

- Relative advantage – Is it superior compare to the existing one?
- Compatibility – Does it fit with his/her values and experience?
- Complexity – Is it difficult to understand or use?
- Divisibility – Can it be used on a trial basis?
- Communicability – Can it be easily observed or described to others?

1.2. Research question

- How an agent based modeling can be developed to explain the role of Twitter in the dissemination of new idea / innovation / product introduction.
- How the receiver of a Twitter message behaves in influencing his/her friends or social networks that he/she belongs to.
- What are the factors that a Twitter message receiver considers prior to re-tweet his/her friends or social networks that he/she belongs to.

1.3. Research objective

- To develop an agent based modeling to explain the role of Twitter in the dissemination of new idea / innovation / product introduction.
- To study the behavior of a Twitter message receiver in influencing his/her friends or social networks that he/she belongs to.
- To find the most important factors that a Twitter message receiver considers prior to re-tweet his/her friends or social networks that he/she belongs to.

2. Literature Review

The diffusion of innovations model (DIM) is concerned with how innovations, defined as ideas or practices that are perceived as new, are spread (Rogers 2003). Diffusion is the process through which an innovation spreads via communication channels over time among the members of a social system. This is a social sciences definition of diffusion, one that is not to be confused with the thermodynamic definition of diffusion. Diffusion occurs in complex systems where networks connecting system members are overlapping, multiple, and complex (Rogers 2003).

Diffusion of innovations theory proposes that adopters of any new innovation or idea can be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%) (Rogers 2003). Diffusion scholars have also studied why some innovations spread relatively rapidly while other innovations do so relatively slowly. Innovations that are perceived as (a) relatively advantageous (over ideas or practices they supersede), (b) compatible with existing values, beliefs, and experiences, (c) relatively easy to comprehend and adapt, (d) observable or tangible, and (e) divisible (separable) for trial, are adopted more rapidly (Rogers 2003).

When the scope of business issues is widened, the characteristics of business processes and phenomena become increasingly non-linear, self-organizing, changing and rationally bounded. However, some kind of method is needed in order to transform into tangible and understandable results, particularly from a management perspective. The rationale behind such a method is that that managers need to be able to test and evaluate different “what-if” scenarios, simulate policy changes or changes in behavior in order for them to understand and evaluate new ways of thinking and approaches. In this regard, one modeling and simulation approach influenced by the complexity paradigm is ABM, which provides a modeling and simulation approach which for a complex adaptive system approach and useful in creating tangible, understandable results for managers (Nilsson, Darley 2006)

As an innovation spreads from early adopters to majority audiences, face-to-face communication therefore becomes more essential to the decision to adopt. This principle is embodied in the Bass Forecasting Model, which illustrates that face-to-face communication becomes more influential over time, and mass media less influential (Rogers 2003). The emphasis on peer-to-peer communication has led diffusion style campaigns now consciously attempt to utilize peer networks, for instance by using Popular Opinion Leader techniques or various “viral marketing” methods. These methods aim to recruit well-connected individuals to spread new ideas through their own social networks.

Peer-to-peer conversation and peer-to-peer network becoming increasingly important because the adoption of new products or behaviors involves the management of risk and uncertainty. It's usually only people that has been known and trusted – and have successfully adopted the innovation themselves – who can give credible reassurances that the attempts to change won't result in embarrassment, humiliation, financial loss or wasted time (Robinson 2009).

Diffusion of innovations theory explains how new ideas and practices spread within and between communities. The basic premise, confirmed by empirical research, is that new ideas and practices spread through interpersonal contacts largely consisting of interpersonal communication. Given the importance of interpersonal contacts in diffusion, scholars have sometimes relied on formal methods of measuring who talks to whom within a community. Such methods are known as network analysis.

Network analysis is a set of methods that enables researchers to locate individuals who are more central to a community and thus perhaps more influential. The basic diffusion network model uses these individuals, or opinion leaders, to initiate the diffusion of a new idea or practice. They can function as champions for the new practice and accelerate the diffusion process. Implicit in the peer promotion model is the assumption that some individuals will act as role models for others (Valente, Davis 1999).

Influential people are individuals with disproportional influence on other individuals. They are thought to have three important traits: 1) they are blessed with an exceptional persuasive power (they are perhaps even charismatic), 2) they know a lot (i.e., are experts), and 3) they have an exceptionally high degree (a large number of social ties). Empirical evidence shows that social hubs adopt relatively early and significantly accelerate the diffusion process (Goldenberg, Lowengart, Shapira 2010)

Agent-based modeling is a new analytical method for the social sciences that is quickly becoming popular as a modeling approach in the social sciences, because it enables one to build models where individual entities and their interactions are directly represented. Agent-based models consist of agents that interact within an environment. Agents are distinct parts of a program that are used to represent social actors (individual people, organizations, or bodies)

which are programmed to react to the computational environment in which they are located. Environment is the virtual world in which the agents act, it may be an entirely neutral medium with little or no effect on the agents. The social network is created by connecting pairs of agents at random, with a parameter used to adjust the number of connection. A model is intended to represent or simulate some real, existing phenomenon, and this is called the *target* of the model (Gilbert 2003).

Currently, the most popular agent-based simulation environment is NetLogo (Wilensky 1999). It includes a user interface builder and other tools such as a system dynamics modeler. It is available for use free of charge for educational and research purposes and can be downloaded from <http://ccl.northwestern.edu/netlogo/>.

3. Research Methodology

The first stage of the study will be conducted by clearly defines the research questions and research objectives in developing agent based modeling to describe the diffusion of innovation using Twitter. After defining the research questions and research objectives, relevant literature review on how to build the simulation models are needed before building the model itself. Secondary data, if any, will be beneficial in supporting the model creation. Qualitative data will be obtained through interviews or questionnaire to provide the initial state of the simulation model to make it closer to the real world.

These qualitative data consist such as:

- the frequency of a Twitter message sender and receiver in using Tweeter.
- the behavior of a Twitter message receiver in influencing his/her friends or social networks that he/she belongs to.
- the factors that a Twitter message receiver considers prior to re-tweet his/her friends or social networks that he/she belongs to.

Once the model design was completed, verification and validation will be conducted to compare the simulation results with real situation. Finally, conclusion and suggestion for further research will be developed accordingly.

4. Purposed Mechanism

4.1. Decision Tree for agent-based simulation model of new product introduction using Twitter

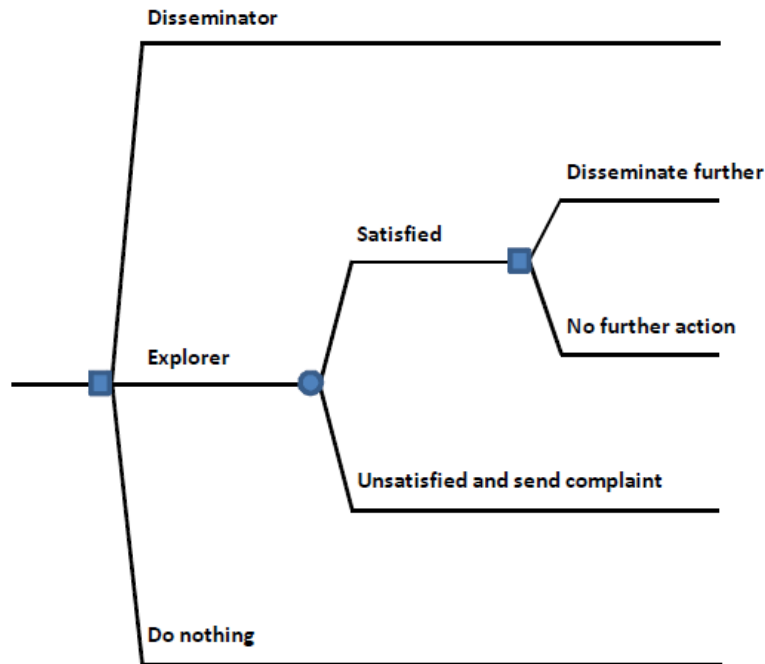


Fig.1 Decision Tree for agent-based simulation model of new product introduction using Twitter

Diffusion of Innovations Theory (Rogers, 2003) proposes that adopters of any new innovation or idea can be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). The assumed proportion for the above decision tree can be categorized as follows:

- Disseminator, who directly disseminates the innovation and consists of innovators and early adopters
- Explorer, who will try or explore the innovation prior to decide whether to disseminate or not, which consists of early majority and late majority
- Ignorant, who ignores the received messages regarding the innovation and do nothing, which consists of the laggards

For the purpose of this paper, an online survey (www.kwiksurveys.com) with 354 responses was conducted to provide an overview about the assumed proportion mentioned above. The survey results in summary can be seen below.

- 95% of the 354 respondents have Twitter account
- 15% of the respondents said that they will re-tweet the information about new food product received through Twitter, 46% decided to try it first and 39% will do nothing.

- From the respondents who decided to conduct the trial, if the trial results exceed their minimum criteria, 74% will re-tweet the information, and the rest (26%) will do nothing.
- From the respondents who decided to conduct the trial, if the trial results below their minimum criteria, 45% will send feedback to the sender, and the rest (55%) will do nothing.

The satisfaction criteria consist of five (5) factors, namely Price, Taste, Packaging, Availability (easy to obtain) and Image (brand reputation). The scores obtained from 354 respondents were varied, ranging from one (1) as the lowest and ten (10) as the highest for each factor. The average (mean) score for Price, Taste, Packaging, Availability and Image were 7, 8, 6, 7 and 6 respectively. Taste is the highest, followed by Price and Availability and then Packaging and Image. These scores will be used as the minimum satisfaction level.

Based on the above survey results, an Agent-Based Simulation Model on New Product Introduction Using Twitter can be developed. The online survey questionnaire is presented on Appendix 1.

4.2. The flowchart of the agent based simulation model

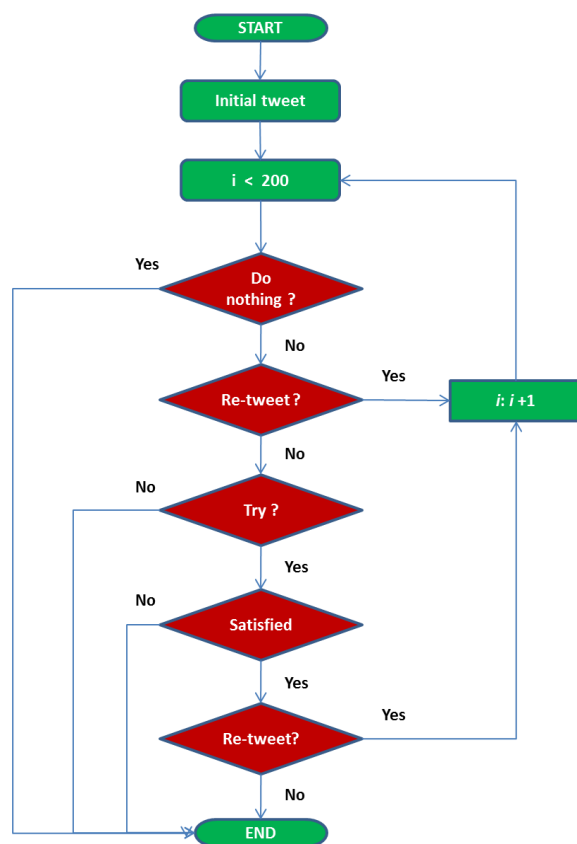


Fig.2 The flowchart of the agent based simulation model

4.3. The interface design of the agent based simulation model

Slider will be used to enable the adjustment of:

- Disseminator
- Number of agents
- Network density
- Price
- Packaging
- Image
- Explorer
- Initial tweets
- Probability to try
- Taste
- Availability

Below is the screenshot of interface design of the agent based simulation model for Twitter.

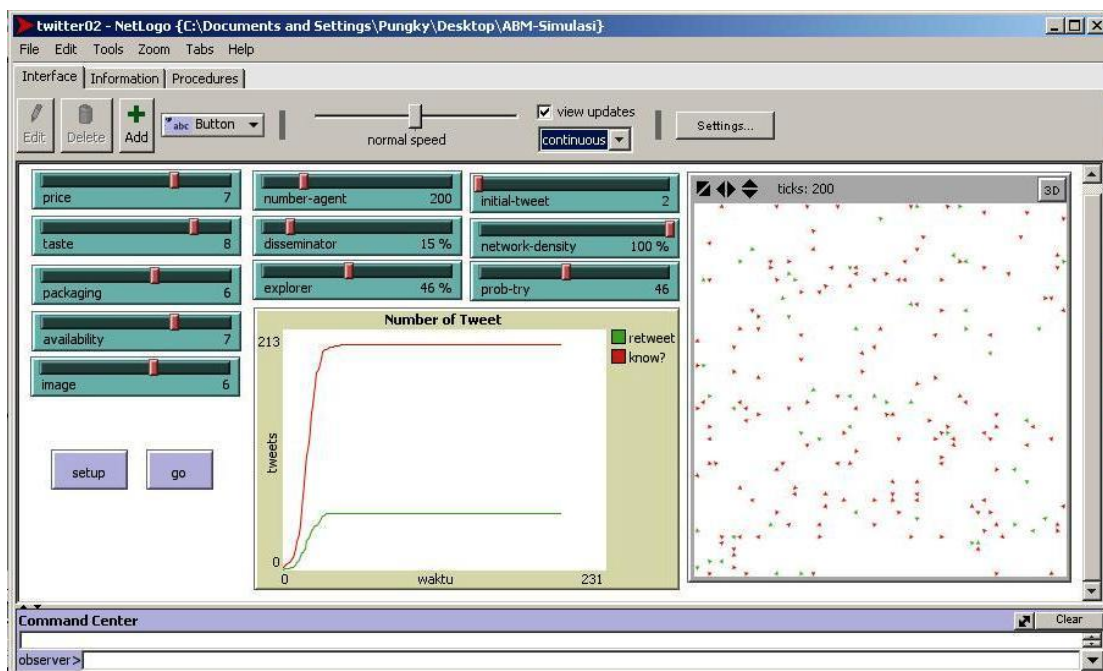


Fig.3 The the screenshot of interface design of the agent based simulation model for Twitter

This Twitter program is inspired by several basic models on the NetLogo model library, such as Diffusion, Explore vs Expolte, Explore vs Expolte1 and Innovazione. However, these basic models only have similarity in small parts and were not close enough to be modified for the Twitter program built for this paper. Therefore this model can be considered as a newly built and can be downloaded from <http://ccl.northwestern.edu/netlogo/models/community/twitter>

4.4. Result of the simulation

The result of the simulation demonstrated that to conduct 213 tweets, it takes only about 1/7 of 231 time units or 33 time units. If cost per million (the common terms to measure the effectiveness of an advertisement) applied to this model, and assuming that 1 time unit equal to 1 second, then to reach 1 million contacts it will require about 43 hours and it will cost around 6% of the subscription fee of unlimited internet service from a wireless telecommunication provider in Indonesia. Thus, it's not surprising that Twitter becomes a favorite choice of a new venture and/or small businesses due to its relatively small amount of money involved in the rapid dissemination of new idea / innovation / new product introduction compare to the conventional advertisement.

5. Conclusions and recommendations

The simulation results indicate that the model appropriately presents the role of Twitter as one of the social networking tool to influence others in introducing new products, in this case new product. The model not only shows the behavior of a Twitter message receiver, but also addresses the most important factors that a Twitter message receiver considers prior to re-tweet his / her friends or social networks that he / she belongs to.

Furthermore, the simulation results also demonstrate the relatively small amount of money involved in the rapid dissemination of new idea / innovation / new product introduction compare to the conventional advertisement.

To improve and enrich the Twitter simulation model, it is recommended to consider the following:

- To widen the scope of the survey to other products, and if necessary, modify the model to properly address the observed product.
- To find other factors of satisfaction criteria which suit best with the nature of the product.
- To select persons which have many Twitter followers prior to disseminate of new idea / innovation / product.

Finally, it is important to note that the speed of information dissemination via Twitter not only applies to good news but also for bad ones as well. Therefore the parties that became the subject of unpleasant news must also respond quickly.

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Appendix 1

Online survey questionnaire

1. Do you have a Twitter account?
 - a. Yes
 - b. No
2. On the estimate, how many follower that you have?
3. What is your action when you receive information about new food product through Twitter?
 - a. Re-tweet
 - b. Try it first
 - c. Do nothing
4. If you decide to try it first, using score 1 – 10, what is your minimum score that you set for the following criteria?
 - a. Price
 - b. Taste
 - c. Packaging
 - d. Easy to obtain (availability)
 - e. Brand reputation (image)
5. When a new food product can fulfill the minimum score that you set for the above 5 factors, will you disseminate again this new food product info (re-tweet)?
 - a. Yes
 - b. No
6. When a new food product failed to fulfill the minimum score that you set for the above 5 factors, will you submit feedback to the sender of this new food product information?
 - a. Yes
 - b. No