IRSTI 004.316.77 https://doi.org/10.26577/1i32jpcsit2303

A.N. Murzakhmetov*, G.S. Borankulova, S.Sh. Dulatbayeva

M.Kh. Dulaty Taraz Regional University, Taraz, Kazakhstan
*e-mail: aslanmurzakhmet@gmail.com

CLASSIFICATION OF THE PROCESS OF INFORMATION DISSEMINATION IN SOCIETY

Abstract. The paper deals with the problems of innovations dissemination in the social system, the dynamics of the spread of innovations in social communities under the influence of the media and the formation of public opinion. The model of innovation dissemination is analyzed, the results of which show that the processes of dissemination of various information messages in social systems can determine mass consciousness and, consequently, mass behavior of people in these social systems. The speed of the spread of innovation depends not only on the geometric distance, but also on the ability and willingness to accept this innovation. If an innovation constantly encounters obstacles in its path, then over time it may lose its power and eventually disappear or transform into a normal state. The results of the research can be useful to support decision-making and in the pronlems of modeling social processes. It also allows to calculate the optimal starting point of an innovation, depending on its basic characteristics. Other advantages include its ability to work at various levels of generalization and the ability to identify socio-cultural barriers to the spread of innovation.

Key words: Diffusion of Innovation, Dynamics of Innovation Diffusion, Social System, Impact of Media, Ideas Spreading in Society, Information Systems.

Introduction

Today web and social networks play an important role in distributing information, interpersonal communication is increasingly transferred to the social networks and in these circumstances web technology has become an effective and instant impact instrument on society and the mass consciousness. Understanding and applying excitement mechanisms through media and internet resources provide information which is necessary to ensure social instability which will surely impact on the state economy.

Public opinion is a state of mass consciousness, which contains implicit or explicit attitude of society or its problems, events and phenomena of reality. Public opinion performs a variety of functions. It can inform, advise, monitor, require the adoption of certain decisions on the most pressing issues affecting the public interest. According to the content of submitted propositions evaluative, goal-setting, and prognostic features of public opinion can be talked. Their qualitative characteristics and expression are determined by the specific object of opinion, the degree of maturity of subject opinions and specific social situation. Public opinion does not only depend on a variety of social factors, but under certain conditions it may have an impact on other social phenomena. There are different approaches to the definition of social systems, but as a rule, among the elements of these systems the followings are distinguished: people and relationship between them, various norms of human activity, social roles and values. Taking it into consideration, we should examine public opinion impact on the relevant elements of different social systems, particularly economy, politics, culture, ethics, ecology, personality and etc [1].

Public opinion is formed by information which is distributed by two main mechanisms:

1) by personal communication of potential information consumers with valid consumers;

2) by influencing on possibility consumers of innovations using mechanisms for the dissemination of innovations such as mass media advertising and social networks.

2. Literature review

Some researchers have studied the diffusion of news or information, and these studies are of particular interest for understanding Media Impacts [2]. P. Deutschmann and Danielson W. investigated the news diffusion and found that they spread much faster than other innovations. This investigation was particularly important, because after it many scientists are interested in news diffusion at the local, national and international levels [3].

The theory of innovation diffusion is important not only for mass communication research, but also has practical applications in many disciplines. This theory became the basis of thousands of scientific papers in the fields such as sociology, social anthropology, economics and medical sociology. Although the impact of the media, study of innovation diffusion isn't usually included in the media impacts research, because some stages of this process are provided by interpersonal communication than media activities [3], [4]. However, in some cases, media has crucial meaning in the process of innovation diffusion. Therefore, basic knowledge of this theory and familiarization with related scientific works are very helpful. What does innovation diffusion mean? "Diffusion of Innovations" is a theory that explains how and why new ideas, products, technologies, or innovations spread and are adopted by individuals or groups over time. This theory was developed by Everett M. Rogers in 1962, and it has been widely used in various fields, including sociology, communication, marketing, and economics, to understand the process of innovation adoption.

The theory of Diffusion of Innovations identifies several key elements and stages in the adoption process:

Innovation: This is the new idea, product, or technology being introduced. It can range from a new smartphone feature to a new farming technique or a medical treatment.

Adopters: These are the individuals or groups who consider adopting the innovation. Rogers categorized adopters into five groups based on their willingness to adopt new innovations: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.

Communication Channels: These are the means through which information about the innovation is spread. Communication channels can include mass media, social networks, word-of-mouth, and more.

Time: The diffusion process takes place over time and can vary significantly in duration depending on the nature of the innovation and the context in which it is introduced.

Social System: The social environment in which the innovation is introduced plays a crucial role. This includes cultural norms, social networks, and the existing infrastructure that can either facilitate or hinder the adoption process.

The Diffusion of Innovations theory also identifies factors that influence the rate of adoption:

Relative Advantage: The extent to which the innovation is perceived as better than the existing solution.

Compatibility: The degree to which the innovation aligns with the values, needs, and experiences of potential adopters.

Complexity: The level of difficulty involved in understanding and using the innovation.

Trialability: The ease with which potential adopters can experiment with or test the innovation.

Observability: The visibility of the innovation's benefits to others, which can influence adoption decisions.

The theory suggests that innovators and early adopters tend to adopt innovations more quickly than the early and late majorities and laggards. Adoption typically follows an S-shaped curve, with a slow start, rapid growth, and eventual saturation.

"Diffusion of Innovations" has been applied in various contexts, such as the adoption of new technologies, the spread of public health practices, the acceptance of new agricultural methods, and the introduction of educational reforms. Understanding this theory can help organizations and policymakers plan strategies to promote the adoption of innovations and manage the challenges associated with their diffusion [5].

2.1. Models of Diffusion Innovations

According to innovation diffusion theory, every innovation (for example, a new idea, method, technology) is diffused, i.e. it is distributed in a society at a certain predictable model. Some people receive innovation immediately as soon as it has been heard. Other people need more time to try something new, and some people take even longer time [6-12]. Furthermore, we will define some diffusion models, where, F – the amount of the potential market, f – the proportion of accepted innovation.

Griliches's diffusion model:

$$P^{*}{}_{it} = \Phi_i P_i (P_i^{*} - P_i) / \mathrm{P}_\mathrm{i}^{*}, \quad P^{*}{}_{it} = \frac{p_{i*}}{1 + e^{-\eta_i - \Phi_i t}}$$

where, Pi – total area, which is sown by hybrid i, Pit is sown by t, ηi – characteristic of the first implementation date, Φi – distribution speed.

Mansfield's diffusion model:

$$\frac{df}{dt} = H(F - f_t)$$

where, $H = (C_1 + C_2\Pi + C_3L + C_4I + C_5C) * f_t / F$ type f(t)- logistic curve, where, П – efficiency, U – risk, I – firm size, C – liquidity, L – commencement date of the new technology use by П, U, L – const.

Floyd's diffusion model:

$$\frac{df}{dt} = bf\frac{(F-f)^2}{F^2}$$

Sharif-Kabir's diffusion model:

$$\frac{df}{dt} = \frac{1}{F}\cdot\frac{(F-f)^2}{F-(1-\sigma)f}f; \quad 0 \le \sigma \le 1$$

when 1 goes to Floyd's model, when 0 – to the Fisher-Pry's model.

NSRT diffusion model:

$$\frac{df}{dt} = b\left(\frac{f}{F}\right)^{\sigma}(F-f), \quad 0 \le \sigma \le \infty$$

Has an analytical solution. When 1 goes to the Fisher-Pry's model, when 0 – to the Coleman's model.

Modified NSRT:

$$\frac{df}{dt} = b\left(1-\frac{f}{F}\right)^{\sigma} f, \quad 0 < \sigma < \infty$$

Generalized rational model:

$$\frac{df}{dt} = b\frac{(F-f)^n f}{F^{n-1}(F-(1-\sigma)f)};$$

$$n = 1,2...; \quad 0 \le \sigma \le 1$$

There is an analytical solution for any values of n. When n=1, 0 goes to exponential model, and also will be 1 – Fisher-Pry's model, if n=2, 0 – Fisher-Pry's model, and also will be 1- Floyd's model. The generalized rational model will have the form:

$$\frac{df}{dt} = b\frac{f^n(F-f)}{F^{n-1}(\sigma F + (1+\sigma)f)};$$

$$n = 1,2...; \quad 0 \le \sigma \le 1$$

And there is an analytical solution for any values of n. When n=1, 0 goes to Coleman's model, when n=1, 1 or n=2, 0 – Fisher-Pry's model, when n=2, 0 – to Floyd's model.

Bewley-Fiebig's diffusion model:

$$\frac{df}{dt} = b(t)f\frac{(F-f)}{F}; \quad b(t) = c\left[(1+kt)^{1/k}\right]^{m-k}$$

where, k characterizes the horizontal scale, m – bend degree.

Model inhomogeneous influence:

$$\frac{df}{dt} = a(F-f) + b\left(\frac{f}{F}\right)^{\sigma}(F-f)$$

when 1 goes to Bass's model.

Robinson-Lakhani's diffusion model:

$$\frac{df}{dt} = (a(F-f) + bf\frac{F-f}{F})e^{-\sigma p}$$

p(t) – price, sensitivity factor.

Mahajan-Peterson's diffusion model:

$$\frac{df}{dt} = a(F_0e^{-\sigma p} - f) + bf(F_0e^{-\sigma p} - f);$$

$$F = F_0e^{-\sigma p}$$

Kalish, Dockher-Jorgensen's diffusion model:

$$\frac{df}{dt} = (\alpha + \beta\varphi(A) + \gamma f + \sigma\varphi(A)f)(F-f)$$

where, A – advertising costs; φ(A) – the function of advertising efficiency.

Coleman/Fourt-Woodlock's diffusion model:

$$\frac{df}{dt} = a(F-f)$$

Type $f(t): f = F(1-\beta^{-at})$ – modified exponent.

Fisher-Pry, Blackman's diffusion model:

$$\frac{df}{dt} = bf\frac{(F-f)}{F}$$

Type $f(t): f = \frac{P}{1+\beta e^{-bt}}$

Bass's diffusion model:

$$\frac{df}{dt} = a(F-f) + bf\frac{(F-f)}{F}$$

Type $f(t): \frac{1-e^{-kt}}{1+qe^{-kt}}; q = \frac{b}{a}; F = 1; k = a+b$

All considered models are based on the S-shaped diffusion curve. Depending on the data, the specific shape of the curves may be different. The most typical S-shaped curve is the logistic function. But in order to describe diffusion processes, other applicable S-shaped curves are used, for example, modified exponential, normal and lognormal distributions, Gompertz curves, Floyd curves, Sharif-Kabir curves [13]. Most researchers, when analyzing and modeling the spread of innovations, use an approach borrowed from the theory of population dynamics of the spread of epidemics. The most popular diffusion models are based on the following suppositions:

1) innovations are constant throughout the entire training period;

2) the number of possible consumers is fixed, but at any moment all consumers can be divided into two groups – those who use innovations, and those who do not use innovations yet;

3) information about new product is distributed by individual contacts between consumers;

4) innovation fills its potential market time by time;

5) current level of distribution has an influence on diffusion speed, i.e. number who has already accepted innovation and the gap between the current usage of limited level of innovation.

Coleman's, Fisher-Pry's, Floyd's, Sharif-Kabir's models present particular cases of models. creation of models are needed. Moreover, Sharif-Kabir's model covers the entire spectral curve from Fisher-Pry to Floyd. Bass F.M. for the first time used a combination of simulation modeling and innovative approaches in his works. His model also describes the diffusion logistic curve process. If F=1, then:

$$f(t) = \frac{1-e^{ct}}{1+qe^{ct}},$$

where, $q = b/a$, $c = a+b$

The variable q shows the coefficient of the relationship a/b between innovation and the modeling effect. If the ratio of variables a/b is close to 0, then the curve f(t) is close to the Fischer-Prye trajectory in its shape, if b is less than a, then this process is close to the Coleman model. This model is an extension of the Bass model, but it includes an unstable simulation coefficient b(t):

$$b(t) = b\left(\frac{f(t)}{F}\right)^{\sigma-1}$$

where, σ – inhomogeneous influence factor, because of:

a) relatively recent consumers may be less receptive to innovation, and then b(t) decreases over time;

b) relatively old consumers may be more susceptible to the impact of innovation old consumers may be more susceptible, in which case and b(t) should be high at the initial moment;

c recent consumers have more information about the product, and accordingly it will be easy for them to assess its quality, therefore, in this case, and b(t) does not increase.

When $\sigma > 1$ b(t) increases, when $\sigma = 1$, b(t) – constant, when $0 < \sigma < 1$ b(t) doesn't increase.

3. Results

Information "contagion" in a crowd is a process in which ideas, beliefs, emotions or information are rapidly distributed among a group of people. This process can take place in the real world, as well as in virtual environments through social media, the Internet and other communication channels. Innovations distribution in the community occurs by interactive mechanism, when the importance of innovation increases according to quantity of innovation consumers. These innovations include, for example, network communication: phone, later: fax, E-mail, Web, cellular communications. Furthermore, let's see the simplest model of innovation distribution «x» in the community. Information "infection" in a crowd can have both positive and negative consequences, depending on what information is distributed and how it is perceived by the audience. It can help mobilize for positive change, but it can also lead to the spread of misinformation or the formation of aggressive opinions. Effective critical thinking and fact-checking play an important role in managing information infection and ensuring reasonable and informed decision-making.

$$\frac{dn}{dt} = \alpha \cdot n \cdot (1-n) \cdot R - \beta \cdot n$$

where: n – number of people "infected" by the idea «x», α – is a number of people who promote the idea «x», β – the "forgetting" coefficient of the idea «x», R – number of resources for propagandizing ideas for "x".

Our experiments show that, if R is increasing and coefficient β is decreasing, the quantity of "infected" grows up with rapid speed (fig. 1).

This model's peculiarity is, when n=0, irrespective of resources contamination doesn't occur, i.e. if idea propagandize people numbers is few, then system is degraded regardless of resources amount R (fig. 2).

Taking into consideration the probability factor of the innovation consumers' decreasing number, which is connected with the information forgetting probability by the user, the schedule system takes the following type (fig. 3).

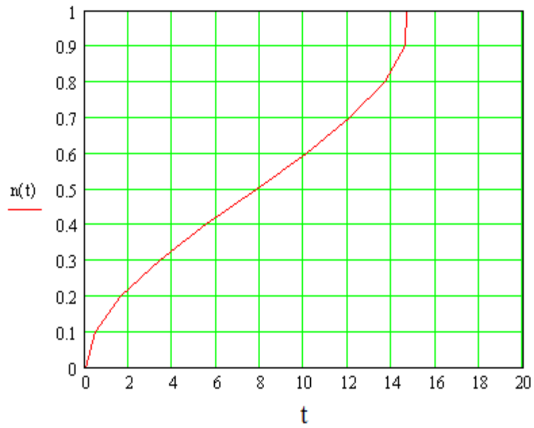

Figure 1 – The dynamics of diffusion of innovation: Positive

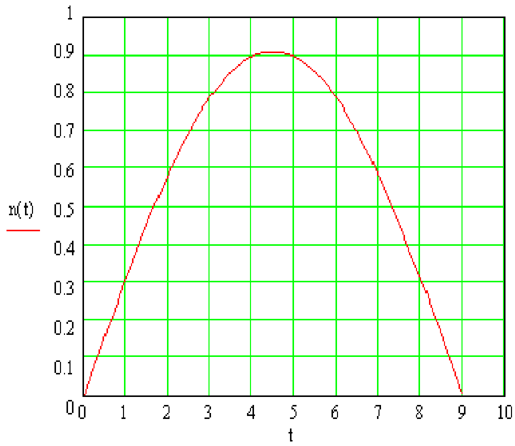

Figure 2 – The dynamics of diffusion of innovation: Negative

The model is notable because in this type of system, there are cyclical increase and decrease of "infected" and resource quantity (fig. 4). The phase portrait of system is a concentric closed curve which around a fixed point called the center. As shown, the fluctuations model number of both variables depend on the initial conditions – after each fluctuation period, the system returns to the same point.

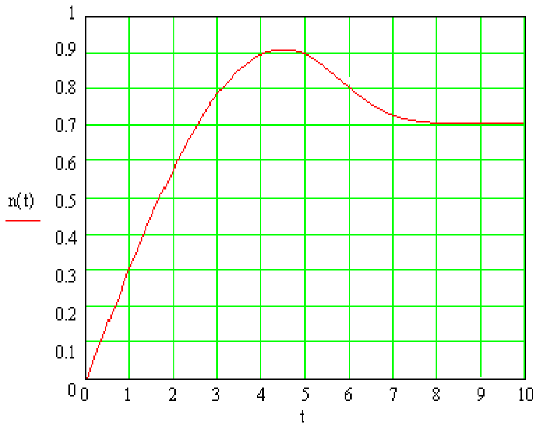

Figure 3 – Positive with forgetting effect

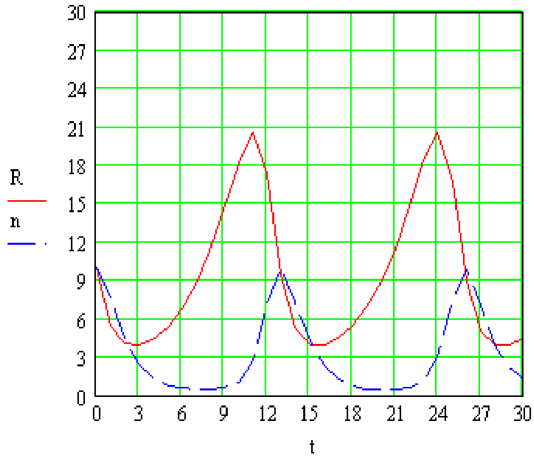

Figure 4 – The cyclic increase and decrease the amount of resource and "infected"

4. Conclusion and discussion

Analyzed models show that in economic forecasting processes public opinion impact takes an important role. The results of various informational messages distribution in social systems can determine the mass consciousness, consequently, also the mass behavior in these systems. To sum up, the public doesn't perceive distribution of new ideas equally, and can divide into groups of who accepts a new idea and doesn't perceive it.

Scientific works on the news impact and its different areas were analyzed during the investigation. They include news subjects, research gap in knowledge, and additional investigations of news memorizing and perception of given topics in it. Possibly, in the future the investigations of all above mentioned problems will continue.

Acknowledgments

This research was funded by a grant for Financing scientific and technical projects for 2023-2025, from Science committee of the Ministry of science and higher education of the Republic of Kazakhstan, grant number "AP19174930".

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