Technology and Investment, 2011, 2, 155-162
doi:10.4236/ti.2011.23016 Published Online August 2011 (http://www.SciRP.org/journal/ti)

Literature Analysis of Innovation Diffusion*

Ying Li, Mengqing Sui
School of Business, East China University of Science and Technology, Shanghai, China
E-mail: *liying@ecust.edu.cn*
Received May 17, 2011; *revised June* 29, 2011; *accepted July* 6, 2011

Abstract

The theory of innovation diffusion has become increasingly complex and multifaceted in recent years. It has been used in consumer durables, services, pharmaceutical industry and other industry research. In this paper, we use literature analysis to study the development of innovation diffusion theory, searching related literatures from Elsevier, EBSCO, Emerald, Scopus and ISI databases published between 1990 and 2010. From these literatures, we analyze the number of literatures, journal distribution, core authors, as well as the main research directions. Then, we get many conclusions which are useful for the future research of innovation diffusion.

Keywords: Innovation Diffusion, Literature Analysis, Number of Literatures, Journal Distribution, Core Authors, Main Research Directions

1. Introduction

The research of innovation diffusion can be traced back to Schumpeter who created innovative theory in the early 20th century, and he studied the "imitation" behavior between individuals. Rogers defined innovation diffusion as a process that innovation spread among the social system through a certain time and specific channels. He proposed that the diffusion process was composed by innovation, communication channels, time, and social system [1]. In 1960s, innovation diffusion theory was used to study marketing, and scholars studied from various angles, such as consumer behavior, sales management, new product market analysis and decision-making. In 1969, the proposal of Bass model [2] had a profound impact in the research of innovation diffusion model. Bass model and its modified model have been widely applied to retail services, consumer durables, industrial technology, agriculture, pharmaceuticals, education and other aspects. Overall, diffusion model can be divided into two categories according to the difference of study objects and methods: One is the macro-level mathematical model based on the overall statistical behavior of potential adopters, the other is the micro-level simulation model based on the individual decision-making behavior of potential adopters [3].

*This paper is funded by Natural Science Fund of China (71071055), Natural Science Foundation of Shanghai (09ZR1407300), Social, Science Fund of Chinese Ministry of Education (09YJC630069).

Innovation diffusion theory is increasingly becoming a focus of academic research, because the ultimate goal of innovation diffusion is to predict the future of new products for enterprises. So the theory can provide decision support when managers develop marketing strategies for new products. With the development of emerging economies, such as services and electronic communications, innovation diffusion theory is more and more used in new areas. The new research breaks through the limitations of original study, demonstrating a broad prospect. In reality, diffusion of new products is affected by products, the environment, communication channels and other factors. And different products have different characteristics, suiting different management methods. The study of new product diffusion model is to predict the future of new product by controlling the regular variables in diffusion process. Thus the research of innovation diffusion has great significance on the management and decision making.

In recent years, many scholars have made certain achievements in their research of innovation diffusion from both breadth and depth. This paper discusses the status and development trend of innovation diffusion research from the perspective of literature analysis. We count and analyze the literature of innovation diffusion theory from 1990 to 2009, summarize the number change, journal distribution and author of innovation diffusion literature at home and abroad. So we can find the research focus and main research directions of the theory

and promote the overall study of innovation diffusion theory, hoping for more deeper and specific research.

Through analysis of innovation diffusion literature in 20 years, we can see that the research of innovation diffusion theory has made significant progress since it was proposed. And the theory is applied to new areas of research by constantly revised, providing theoretical guidance for the launch of new products. The future of innovation diffusion theory research is promising:

1) Innovation diffusion theory is used more and more in the emerging economies such as electronic communications, services, pharmaceutical industry and so on. With the development of technology, innovation diffusion in emerging economies will become a particular concern area in innovation diffusion research. And the difference of emerging products will lead to different focus of diffusion research.

2) The focus of innovation diffusion research will change into research based on individual decision-making behavior from study based on statistical behavior of the overall. Effective study about individual decision-making is important to enterprise management decision. Some scholars proposed that individual decision-making can be divided several stages to study, which included observation, considering, like, choose, purchase and repeat purchase. Some other people considered group decision-making to the model, that is, purchase of products is determined by several people. Similar studies have yet to be more and concreted.

3) Research of innovation diffusion will extended to two dimensions of space and time from a single time dimension. At present, many scholars introduce the concept of network externalities, thinking that diffusion is effected by social networks. For example, study about multi-country diffusion, that is different cultural or economic resources in different countries can affect diffusion of the same products. Now, there is more research about new products diffusion along time, for example, study about life cycle of products, while study about spatial diffusion is less, so this is a focus of future research.

4) Research of technical alternatives will be further deepened. The end of a product is often due to the emergence of new products with new features. So in recent years, scholars concern technical alternatives much more. Now a lot of research is about whether technical alternatives can promote product diffusion, so related research should be extended to a deeper level in the future. Such as: products coexistence in alternative process, impact of the customer heterogeneity to technology updates, launch time of new product and forecast of the diffusion effect.

5) Further relaxation of the constraints in classic Bass model. Now many scholars have considered the market competition, marketing mix, customer relationship, market supply and demand and other factors into innovation diffusion model, making related research increasingly rich. While there is much breakthrough progress in many areas, the research is still insufficient. So the task of study about model extension is still arduous.

6) Empirical research of innovation diffusion will increase. Currently research of innovation diffusion has focused on simulation of diffusion process, and empirical research on products is relatively small, because data acquisition is difficult. But now with the development of network, many companies have their own comprehensive database and customer relationship management systems, it will be much more convenient for data acquisition, and empirical research on innovation diffusion will increase.

7) Although innovation diffusion research has been formed a field, as a multidisciplinary academic field, in order to obtain greater development and impact, we need to blend it with other disciplines, learn other effective methods, concern mainstream areas, and publish more papers in publications of other disciplines.

2. Materials and Methods

We search for related articles from the database of Elsevier, EBSCO, Emerald, Scopus and ISI between 1990 and 2009, using topic search and keyword search. The search words are innovation diffusion, diffusion of innovation or new product diffusion.

After retrieving the relevant literature in this way, we import the literature to Endnote software. And then we exclude the same literatures which are included in multiple databases simultaneously using the eliminating duplication function of Endnote, and obtain 3919 non-duplication literature at last.

Then we analyze the research status of innovation diffusion literature in twenty years. This article mainly analyzes the number, journals, authors and research interests of the literature in this field. Finally, we have a summary for the research of innovation diffusion.

3. Literature Analysis

3.1. Quantitative Analysis of Literature

The number of papers published in a field is an important indicator to reflect the pace and level of subject development. This paper analyzes the number of papers in innovation diffusion with the Subject Bibliography function of Endnote, as shown in **Figure 1**.

We have collected 3230 literature about innovation diffusion, of which only 695 is between 1990 and 1999, while there are 2535 papers from 2000 to 2009, occupying 78.5% of all the literature. This shows that the papers of innovation diffusion have grown rapidly since 2000. We can divide it into three stages according to the num-

ber change of papers:

1) Literature from 1990 to 1999 keeps rising, but at a lower volume level. There are fluctuations in some years, showing that the research of innovation diffusion was still unstable during this period, having no clear field of study, and didn't arouse enough attention.

2) The number of papers has grown rapidly since 2000. For example, papers in 2005 increased 40% compared to 2004. So papers of innovation diffusion have maintained sustained, stable and rapid growth on a level of high number. And the number of 2008 is the biggest.

3) Since the data in 2009 is yet incomplete (the deadline of statistic is in October, 2009), the decrease in 2009 shown in **Figure 1** is inaccurate. So we won't analyze it in detail.

Overall, the research of innovation diffusion theory is more and more, for the following reasons:

1) In-depth study of innovation diffusion models. Bass model proposed in 1969 is the main platform for innovation diffusion studies, and the study has been mainly concentrated in two areas since 1990:

a) The improvement or expansion of Bass model, including adding diffusion channels [4-5], competition [6-7], technology update [8-9], repeat purchase [10], bundling [11] and other factors to Bass model.

b) Construction of new model separated from Bass model. These models focus on the simulation of the adoption behavior of individual consumers, mainly using the method of Agent-based modeling, such as neural networks, cellular automata, small world network and so on. These models try to study diffusion problems from heterogeneity of consumers, word of mouth, social network and other angles.

2) The increase of study perspective in innovations diffusion. With the development of information, entertainment, communications, service industries and the competition in global market, diffusion of new products becomes more and more complex. So the research on innovation diffusion is more diverse.

a) Research of consumer heterogeneity. Consumers' different preferences on price [12], risk [13], brand [14] etc can affect diffusion of products. Early studies only focused on word of mouth, that is, communication between consumers.

b) Research of social networks. Exchanges between consumers are affected by its host network, including the study of network externalities [15], network information [16], and network structure [17].

c) Research of spatial diffusion. More and more research considers the spatial diffusion of innovation, not just diffusion over time. For example, there is research about cross product diffusion in different cultural resources [18] or different economic resources [19].

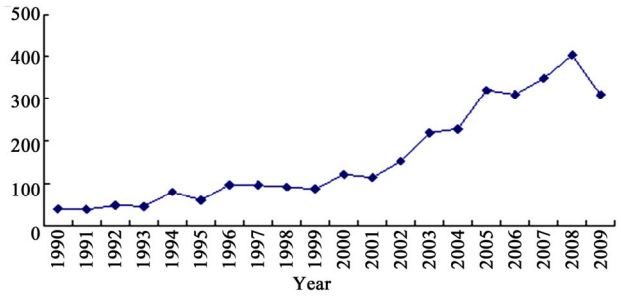

Figure 1. Number distribution of literatures.

3.2. Analysis of Published Journals

There is an interactive relationship between the publications and authors in a particular subject area. Each publication has its editorial policy and subject positioning. For authors, they will understand the position of publications firstly, and then post their papers to related publications. Through such interaction, there will be a trend that articles in a certain field will focus on specific publications. So from the number of published articles, we can see that some publications issue much more papers than other publications.

Table 1 lists the top twelve publications in the number of articles published in the field of innovation diffusion among from 1999 to 2009.

We can see the concentration of papers from **Table 1**, which is the proportion of paper number in the top 12 journals accounting for the total number of articles in the same period. The search results in the five database is that there are totally 3919 papers on innovation diffusion from 1990 to 2009, while there are 538 papers in the top 12 publications, accounting for 13.7%. The first publication (Technological Forecasting and Social Change) has 91 papers, accounting for 2.3%. Such a concentration is not high for a specific subject area.

Table 1. Ranking of published journal.

Ranking	Journal Title	Number of Papers
1	Technological Forecasting and Social Change	91
2	Research Policy	70
3	Social Science and Medicine	58
4	Energy Policy	49
5	Technovation	47
6	Harvard Business Review	43
7	Health Care Management Review	41
8	Studies in health technology and informatics	33
9	International Journal of Technology Management	28
10	International Journal for Quality in Health Care	27
11	Marketing Science	26
12	Journal of health communication	25

After specific analysis for publications, we can draw the following conclusions:

1) Diffusion of technological innovation is the most important in innovation diffusion research. Many scholars study technological innovation from the angle of establishment of technical innovation system, operation mechanism, enhancing the innovative capacity and so on. Because the ultimate goal of business innovation is the success of innovation diffusion, study about technology innovation diffusion process and the influence factors is more and more. In recent years, many scholars have a strong interest in technological update, but scholars have different views about whether technology update can promote the products diffusion [20-21]. Some scholars compared the new product diffusion caused by technological update to innovation diffusion in single technology, they considered that diffusion of technology updates can increase market potential and reflect the impact of consumer heterogeneity [22-23].

2) Innovation diffusion theory is applied to the study of emerging industries, such as pharmacology, consumer durables, electronic communications, entertainment products and so on. For example, Hahn [24] analyzed the "trial—then buy" diffusion process in pharmaceutical industry using a four-stage model. Melnikov [25] proposed a dynamic diffusion model to study consumer demand for differentiated durable goods. Krishnant [26] studied the diffusion of mobile phones. Lee [27] established a model to predict the differences of individual in new entertainment products. Thus, with the social progress, technological development and the continuous rise of emerging industries, the application of innovation diffusion theory will continue to be expanded, and such study will have good prospects.

3) Research of innovation diffusion will increasingly focus on the combination of theoretical research and reality, trying to provide a theoretical basis for managers to develop marketing strategy for new products, while the focus of previous study is creation and improvement of models. But recently along with the rapid development of network blog, electronic communication, customer relationship management, services industry and so on, more and more scholars begin to have empirical study of new product diffusion overcoming the difficulties in data acquisition, trying to provide realistic basis for theoretical research. For example, Landsman, Givon [28] analyzed diffusion of financial products using bank data. Holak [29] found that consumers' expectation of quality is related to purchase intention according to his empirical study. In addition, many scholars combined the results of their study to the decision-making of managers, providing theoretical guidance for making diffusion strategy of new products.

3.3. Analysis of Authors

Table 2 is the statistic of authors having the most published papers. Through analysis of authors and the number of their papers, we can also see the development of innovation diffusion research.

Firstly, from authors and the number of their papers, we can see that innovation diffusion theory is developing rapidly. There are many authors, but most of them have few papers, showing that the core group of researchers remains to be formed and stable. But as shown in **Table 2**, recently it has emerged a number of authors who published more than seven articles. And it has already existed obvious difference among topics of authors. These authors have formed their own unique areas of research, which will be the core of innovation diffusion research.

Table 2. Ranking according to paper numbers of authors.

Ranking	Author	Number	Coutry	Work Unit
1	Muller, Eitan	14	Israel	Tel Aviv University
2	Menachemi, Nir	11	United States	Florida State University
2	Watanabe, Chihiro	11	Japan	Tokyo Institute of Technology
3	Mahajan, Vijay	10	United States	Southern Methodist University
4	Lyytinen, Kalle	9	United States	Case Western Reserve University
5	Tellis, Gerard J.	8	United States	University of Southern California
5	Tung, Feng-Cheng	8	Taiwan	National Cheng Kung University
5	Valente, Thomas W.	8	United States	University of Southern California
5	Brooks, R. G.	8	United States	Texas Tech. University
6	Bass, F. M.	7	United States	University of Texas
6	Blumenthal, D.	7	United States	Harvard Medical School
6	Karmeshu	7	India	Jawaharlal Nehru University
6	Kraemer, Kenneth L.	7	United States	University of California
6	Mesak, Hani I.	7	United States	Louisiana Tech. University
6	Newell, Sue	7	England	Nottingham Trent University
6	Vishwanath, Arun	7	United States	State University of New York

Secondly, from the country and work units of core authors as shown in **Table 2**, we can see that there are eleven Americans in the top 16 authors while the nationality distribution of the rest authors is more dispersed. So it is clear that the forefront of innovation diffusion is still in the United States, and the research of other countries is much scarcer. Most authors published one or two papers, so they haven't formed obvious research teams. From their work units, we can found that the most important teams of innovation diffusion research focus on universities, while government's research team and the semi-official research institutes in this field are to be strengthened.

3.4. Analysis of Research Content

Refviz is used to analyze mass literature combined with Endnote. The principle of Refviz is similar to the way we read literature: Read all literature, identify key information, and then classify the literature, displaying the results of classification with visual graphics. This can help us find hot spots and the relationship among papers, so we can understand the overall situation of the field quickly. **Figure 2** shows the "major topic" and "minor topic" which are used by Refviz to classify the innovation diffusion literature. Now we classify and analyze the 3230 papers according to this.

From above analysis, we can see that since Rogers proposed innovation diffusion theory, it has been widely applied to service industries, retail, pharmaceutical industry and other directions. In order to study the "imitation" behavior between individuals in diffusion process, many scholars begin more extensive study for diffusion models. As we see from **Figure 2**, papers studying model accounts for one-fourth of the total literature. The second one "adoption" shows that a large area of innovation diffusion literature is to study the adoption behavior. Let's analyze the following keywords simply. "Health" and "care" show that innovation diffusion theory is widely used in pharmaceutical industry. "Practice" and "policy" represent that the theory has been applied to

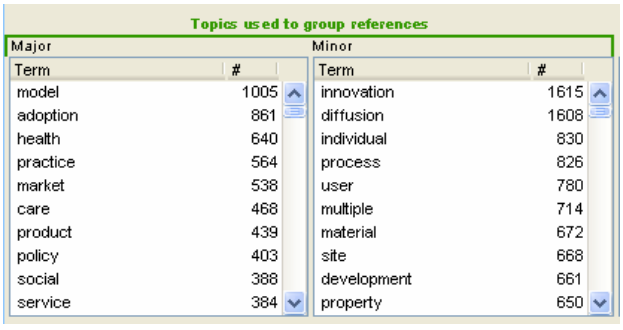

Figure 2. Key words of classification.

practice, providing theoretical guidance for managers to develop marketing strategy for related products. "Market" and "product" show that the application of the theory is rich in the market and product diffusion. "Social" stands for the research of innovation diffusion theory of the social point. At last, "service" stands for the application in services.

1) Research on models

After further analysis of innovation diffusion models, we can find that the literature on diffusion models can be divided into two categories according to the difference of research subjects and methods.

One is the macro-level mathematical model based on the overall statistical behavior of potential adopters. Macro-model was first proposed by Fourt [30], Mansfield [31], Bass [2] and so on, in which Bass model and its extended models are the main representative. Mathematical model is the most mature diffusion model which is used widely, and most diffusion models belong to this category. Through scholars' continuous expansion, such diffusion models have been used to study problems in various fields, such as market mix strategies, competition, advertising, pricing, repeat purchase, technology substitution and so on.

The other is the micro-level simulation model based on the individual decision-making behavior of potential adopters. With the development of computer, micro-simulation models are increasingly used in innovation diffusion research. The basic idea of micro-simulation model is to obtain the macro results by simulating the behavior of individual and interaction between individuals. Such models mainly include multi-Agent model [32], percolation model [33], critical value model [34], cellular automata [35] and so on. Although these models are different in forms or building methods, the basic ideas are similar. CA model is the most important tool for analyzing complex systems. And it is widely used in transportation, finance, infectious diseases, mass media and other areas of research.

2) Research on adoption behavior

The research about adoption decision mainly studies the factors influencing individual adoption from the angle of individual. Such research from individual perspective compensates the lack of study from overall angle, and considers individual heterogeneity and foresight.

Heterogeneity comprises all related individual characteristics affecting the adoption of new products, such as different economic bear ability, different living habit, different preferences of risk and brand, different sensitivity of price and so on. Many scholars take this heterogeneity to the diffusion model constructed from individual angle, and attempt to verify the effectiveness of the model prediction through empirical analysis. For example, Bridges [36] constructed a model to investigate how

consumers' expectation of price affected the market share of high-tech products. The empirical research found that the relative market share of computer was inversely related to the expectation.

Foresight refers to the waiting of individual until the price or quality of new products reaching to an acceptable level. Because search of information needs cost, individual with foresight will decide the time of adoption after comparing utility of purchase now or future based on their expectation of the future price, future quality and future brand, in order to realize the largest effectiveness. Many scholars considered the effect of individual expectation to new products' future price and quality when they study individual purchase behavior and new product diffusion model. For example, Winer [37] considered consumer's price expectations and the uncertainty of the expectation as constructing the model, in order to explain consumer's demand for durable goods. The empirical research shows that the expectation effected the adoption decision of consumer.

4. Conclusions

Through the analysis of innovation diffusion literature in 20 years, we can see that the research of innovation diffusion theory has made significant progress. The theory is applied to new areas more and more, and the modified diffusion models are more able to provide theoretical guidance to new products' diffusion. Based on above analysis of innovation diffusion literature, we get the following conclusions:

1) Macro research literature is more than micro research literature, and Bass model is the main tool for macroeconomic research. Focus of Bass model is the effect of marketing variables (such as advertising, reputation, price and competition) to new product sales and market share. Because sales of new products and market share are all micro-aggregated variables of consumer purchase behavior, Bass model is also known as the macro-variable model of innovation diffusion. Bass model successfully fitted the historical diffusion date of new products, and led more than 850 papers about the follow-up model and its application. While the Bass model of innovation diffusion occupies an important position, it still has two important deficiencies:

a) As a macro model, Bass model is short of micro-mechanism. It does not consider the microscopic mechanism emerging from macroscopic characteristics of the system;

b) Suppose of homogeneous market. Bass model assumes that all consumers have the same preferences and behavioral characteristics, which is contrary to the economic theory of different consumer preferences and the reality.

2) Micro-research literature is increasing. Because of the defect of Bass model, many scholars have begun to study micro model of innovation diffusion since the 1990s. And simulation models of complex systems become the forefront topic of innovation diffusion research because it can reveal the microscopic mechanism of macroscopic characteristics. It not only overcomes the two important shortcomings of Bass model, but also has features of effectiveness and stability in the early prediction of innovation diffusion. Simulation models of complex systems use simulation software as the computing platform, and simulate innovation diffusion process under the background of various marketing strategies and systems by setting the system parameters, which can help companies develop the best market strategy for new products. Microscopic model can enhance the explanatory power and predictive validity of innovation diffusion as a new research paradigm. It can not only reveal the links between the individual behavior and macroscopic characteristics of the system, but also can test and compare the effects of various marketing strategies effectively, thus opening up new directions for the study of innovation diffusion.

3) From the analysis of innovation diffusion literature, we found that theoretical research is much more than empirical research. Since Bass model was proposed, many scholars have repeatedly tested the structure, concept assumptions and parameter estimation of the model, trying to amend it further. Along with the rapid development of computer technology, more and more scholars use simulation methods to have a microcosmic study of innovation diffusion since the 1990s. However, empirical research is always little, model parameter settings and simulation results lacks evidence support. The existing innovation diffusion research based on complex system simulation, either ignores the empirical evidence of parameter settings in simulation model, or lacks empirical tests for the simulation. In fact, not only conclusions of the simulation model, but also the building of simulation models needs empirical test. If parameters of the model are set optionally, it will affect the general applicability and objectivity of simulation conclusions.

4) From analysis of literature number, important publications and authors, we find that American scholars are leaders of this field, playing an important role in research of innovation diffusion, while most other countries are still in the stage of development. The gap with American in this field is not only in quantity but also in lacking of local empirical research, theoretical innovation, broad international perspective and academic standard. Therefore, in order to enhance the overall research level of innovation diffusion theory, scholars in every country need to have more extensive and in-depth research.

5. Acknowledgements

This work is supported by Natural Science Fund of China, Natural Science Foundation of Shanghai and Science Fund of Chinese Ministry of Education. The authors are thankful to their colleagues in East China University of Science and Technology.

6. References

[1] E. M. Rogers, "Diffusion of Innovations," The Free Press, New York, 1995.

[2] F. M. Bass, "A New Product Growth Model for Consumer Durables," *Management Science*, Vol. 15, No. 5, 1969, pp. 215-227. doi:10.1287/mnsc.15.5.215

[3] P. Renana, M. Eitan and M. Vijay, "Innovation Diffusion and New Product Growth Models: A Critical Review and Research Directions," *International Journal of Research in Marketing*, Vol. 2, No. 27, 2010, pp. 91-106.

[4] M. Jones and C. J. Ritz, "Incorporating Distribution into New Products Diffusion Models," *International Journal of Research in Marketing*, Vol. 8, No. 6, 1991, pp. 91-112. doi:10.1016/0167-8116(91)90018-3

[5] A. Rangaswamy and S. Gupta, "Innovation Adoption and Diffusion in the Digital Environment: Some Research Opportunities," Kluwer Academic, Boston, 2000.

[6] R. J. Kauffman and A. Techatassanasoontorn, "International Diffusion of Digital Mobile Technology: A Coupled-Hazard State-Based Approach," *Information Technology and Management*, Vol. 6, No. 3, 2005, pp. 253-292. doi:10.1007/s10799-005-5882-3

[7] C. Van den Bulte and S. Stremersch, "Social Contagion and Income Heterogeneity in New Product Diffusion: A Meta-analytic Test," *Marketing Science*, Vol. 23, No. 4, 2004, pp. 530-544. doi:10.1287/mksc.1040.0054

[8] P. Bass and F. M. Bass, "IT Waves: Two Completed Generational Diffusion Models," University of Texas, Dallas, 2004

[9] N. Kim, D. R. Chang and A. D. Shocker, "Modeling Intercategory and Generational Dynamics for a Growing Information Technology Industry," *Management Science*, Vol. 46, No. 4, 2000, pp. 496-512. doi:10.1287/mnsc.46.4.496.12059

[10] P. R. Steffens, "A Model of Multiple Ownership as a Diffusion Process," *Technological Forecasting and Social Change*, Vol. 70, No. 2, 2002, pp. 901-917.

[11] S. Gupta, D. C. Jain and M. S. Sawhney, "Modeling the Evolution of Markets with Indirect Network Externalities: An Application to Digital Television," *Marketing Science*, Vol. 18, No. 3, 1999, pp. 396-416. doi:10.1287/mksc.18.3.396

[12] E. Bridges, C. K. Yim and R. A. Briesch, "A High-Tech Product Market Share Model with Customer Expectations," *Marketing Science*, Vol. 14, No. 1, 1995, pp. 61-81. doi:10.1287/mksc.14.1.61

[13] R. Chatterjee and J. Eliashberg, "The Innovation Diffusion Process in a Heterogeneous Population: A Micro Modeling Approach," *Management Science*, Vol. 36, No. 9, 1990, pp. 1057-1079. doi:10.1287/mnsc.36.9.1057

[14] B. Libai, E. Muller and R. Peres, "The Influence of within-Brand and Cross-Brand Word of Mouth on the Growth of Competitive Markets," *Journal of Marketing*, Vol. 73, No. 2, 2009, pp. 19-34. doi:10.1509/jmkg.73.3.19

[15] S. Stremersch, G. J. Tellis, P. H. Franses and J. L. G. Binken, "Indirect Network Effects in New Product Growth," *Journal of Marketing*, Vol. 71, No. 3, 2001, pp. 52-74. doi.org/10.1509/jmkg.71.3.52

[16] C. Van den Bulte and S. Stremersch, "Social Contagion and Income Heterogeneity in New Product Diffusion: A Meta-analytic Test," *Marketing Science*, Vol. 23, No. 4, 2004, pp. 530-544. doi.org/10.1287/mksc.1040.0054

[17] G. Kossinets and D. J. Watts, "Empirical Analysis of an Evolving Social Network," *Science*, Vol. 311, No. 5757, 2006, pp. 88-90. doi:10.1126/science.1116869

[18] W. Redmond, "Diffusion at Sub-national Levels: A Regional Analysis of New Product Growth," *Journal of Product Innovation Management*, Vol. 11, No. 2, 1994, pp. 201-212. doi:10.1016/0737-6782(94)90003-5

[19] R. Desiraju, H. Nair and P. Chintagunta, "Diffusion of New Pharmaceutical Drugs in Developing and Developed Nations," *International Journal of Research in Marketing*, Vol. 21, No. 4, 2004, pp. 341-357. doi:10.1016/j.ijresmar.2004.05.001

[20] J. H. Pae and D. R. Lehmann, "Multigeneration Innovation Diffusion: The Impact of Intergeneration Time," *Journal of the Academy of Marketing Science*, Vol. 31, No. 1, 2003, pp. 36-45. doi:10.1177/0092070302238601

[21] B. L. Bayus, "Are Product Life Cycles Really Getting Shorter," *Journal of Product Innovation Management*, Vol. 11, No. 4, 1994, pp. 300-308. doi:10.1016/0737-6782(94)90085-X

[22] J. Goldenberg and S. Oreg, "Laggards in Disguise: Resistance to Adopt and the Leapfrogging Effect," *Technological Forecasting and Social Change*, Vol. 74, No. 8, 2007, pp. 1272-1281. doi:10.1016/j.techfore.2006.11.001

[23] V. Mahajan and E. Muller, "Timing, Diffusion, and Substitution of Successive Generations of Technological Innovations: The IBM Mainframe Case," *Technological Forecasting and Social Change*, Vol. 51, No. 2, 1996, pp. 109-132. doi:10.1016/0040-1625(95)00225-1

[24] M. Hahn, S. Park, L. Krishnamurthi and A. Zoltners, "Analysis of New Product Diffusion Using a Four Segment Trial Repeat Model," *Marketing Science*, Vol. 13, No. 3, 1994, pp. 221-247. doi:10.1287/mksc.13.3.224

[25] Melnikov, "Demand for Differentiated Durables Products: the Case of the US Computer Printer Market," Working Paper, Department of Economics, Yale University, New Haven, 2000.

[26] V. Krishnant, F. Bass and V. Kumar, "Impact of a Late Entrant on the Diffusion of a New Product or Service," *Journal of Marketing Research*, Vol. 37, No. 2, 2000, pp.

269-278. doi:10.1509/jmkr.37.2.269.18730

[27] J. A. Lee, P. Boatwright and W. A. Kamakura, "Bayesian Model for Prelaunch Sales Forecasting of Recorded Music," *Management Science*, Vol. 49, No. 2, 2003, pp. 179-196. doi:10.1287/mnsc.49.2.179.12744

[28] V. Landsman and M. Givon, "The diffusion of a New Service: Combining Service Consideration and Brand Choice," *Quantitative Marketing and Economics*, Vol. 8, No. 1, 2010, pp. 91-121. doi:10.1007/s11129-009-9077-9

[29] L. Holaks, D. R. Lehmann and F. Sultan, "The Role of Expectation in the Adoption of Innovative Consumer Durable: Some Preliminaly Evidence," *Journal of Retailing*, Vol. 63, No. 3, 2987, pp. 243-259.

[30] L. A. Fourt and J. W. Woodlock, "Early Prediction of Market Success for New Grocery Products," *Journal of Marketing*, Vol. 25, No. 2, 1960, pp. 31-38. doi:/10.2307/1248608

[31] E. Mansfield, "Technical Change and the Rate of Imitation," *Econometrica*, Vol. 29, No. 4, 1961, pp. 741-756. doi:10.2307/1911817

[32] X. G. Gong and Z. C. Li, "Study on Multi-agent Simulation of New Product Market Diffusion," S*ystems Engineering Theory & Practice*, Vol. 12, No. 12, 2003, pp. 59-63.

[33] J. Goldenberg B. Libai S. Solomon, N. Jan and D. Stauffer, "Marketing Percolation," *Physica A*, Vol. 284, No. 1-4, 2000, pp. 335-347.

[34] M. Granovetter, "Threshold Models of Collective Behavior," *American Journal of Sociology*, Vol. 83, No. 6, 1978, pp. 1420-1443. doi:10.1086/226707

[35] J V. Neumann and A W. Burks, "Theory of Self-Reproducing Automata," University of Illinois Press, Urbana, 1966.

[36] E. C. K. Bridges, R. Yim and A. Briesch, "A High-Teeh Product Market Share Model with Customer Expectations," *Marketing Science*, Vol. 14, No. 1, 1995, pp. 61-81. doi:10.1287/mksc.14.1.61

[37] R. S. Winer, "A Price Vector Model of Demand for Consumer Durables: Preliminary Developments," *Marketing Science*, Vol. 4, No. 1, 1985, pp. 74-90.

