关于创新扩散的文献计量分析

一、引言

扩散理论的发展最早可以追溯到 19 世纪的欧洲，其重要的来源有法国加布里埃尔·塔尔德（Garbriel Tarde）的“模仿定律”与德国格奥尔·齐美尔（Georg Simmel）的“陌生人”理论等。创新扩散研究领域公认的大师罗杰斯（E. M. Rogers）在其著作《创新的扩散（第五版）》中总结了创新扩散的四要素：创新、沟通渠道、时间和社会体系；创新扩散研究的八大类型：创新的早期认知、社会体系内不同创新的采纳率、创新精神、意见领袖、扩散网络、不同社会体系的创新采用率、沟通渠道的使用以及创新的结果，以及该领域研究的四大缺陷：过度重视创新偏见，个体指责偏见，回忆问题以及公平性问题。[1] 然而遗憾的是，罗杰斯于 2004 年已经仙逝。在历经了十多年的发展之后，现阶段的创新扩散研究呈现怎样的发展现状，是本文关注的要点。得益于技术的飞快发展，我们通过文献计量学的方法可以对创新扩散研究进行系统性的文献研究，与大师著作里的内容进行补充与应证。

扩散研究关注创新在一个社会体系内时间、空间的传播，以此赋予了行为改变进程的“生命”，通过把时间作为基础因素来加强对人类行为改变的概念化总结和分析。

二、研究方法

根据（Zupic & Cater 2015）[2]提出的普适性的文献计量研究流程应该包括 5 个流程：研究设计、数据收集、数据分析、数据可视化、阐释。以下为本文的研究流程：

（一） 研究设计

研究设计部分主要是对研究问题进行定义，本文的研究方向主要在于：（1）识别创新扩散相关研究的知识基础以及知识结构；（2）发现该领域的概念结构。本文选用的分析工具为 M. Aria 博士创建的文献计量分析程序 Biblioshiny 3.0。

（二） 数据收集

本文的元数据来源于 Web of Science (WoS)，检索方式为“标题 = diffusion of innovations”，“文件类型 = article AND review”，“语言 = English”，文献收集时间为 2020 年 12 月 9 日。共收集到 987 条文献记录，并保存为 txt. 格式的文件。

（三） 数据分析

本文的数据处理与分析采用 Biblioshiny 程序。Biblioshiny 是 M. Aria 教授基于 R 语言的 shiny 软件包，将 bibliometrix 核心代码封装，所建立的一个易于操作的网页程序。这个工具可以帮助研究者进行全流程的文献计量工作与可视化的展示。而本文主要用到的数据分析方法有：描述性的数据统计、文献共引分析、关键词共现分析、多元对应分析、聚类分析以及直接引文网络分析。其中文献共引分析有助于发现该研究方向的基础知识，引文网络分析有助于发现其研究流派，关键词的共现分析、多元对应分析所形成的聚类有助于发现研究方向的概念结构。

（四） 数据可视化

对应研究问题与数据分析所使用的方法，可视化的呈现方式主要有：柱状图、树图、词云图、因子图、引文网络、共引网络、共现网络等，以展示该研究方向的知识结构与概念结

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[1] E.M.Rogers. 《创新的扩散（第五版）》

[2] Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods, 18*(3), 429–472.

构。

（五） 阐释

针对研究问题，对于文献计量分析产生的结果主要做三方面的阐释：该研究方向的基本情况（主要期刊、作者、研究机构、国家等），文献阐释（直接引文脉络与共引分析所展现的知识基础），关键词阐释（共现分析与因子分析所展现的概念结构）。

三、结果展示

表一主要展现了本次数据分析所采用的元数据的基本情况，时间段是在 1957—2000 年，文件数量总共为 987 篇，引用的文献达 35241 篇，关键词集为 1639 条，作者的关键词集为 2117 条。

这里需要加以区分的是扩展的关键词集（Keywords Plus）与作者的关键词集（Author's Keywords）。通常认为，Keywords Plus 在共现分析/因子分析中可以帮助研究者更好地把握文献的抽象概念与大的方向。而 Author's Keywords 更有利于帮助研究者观察具体文献内容的表征。（Zhang et al 2016）

表一：

Description	Results
Period	1957：2020
Documents	1200
References	41213
Authors	2648
Sources (Journals, Books, etc)	707
Average years from publication	14.4
Average citations per documents	34.83
Keywords Plus (ID)	1825
Author's Keywords (DE)	2516
Co-Authors per Documents	2.49
Collaboration Index	2.72

（一） 主要期刊与作者

本节主要介绍了创新扩散研究领域重要的 10 份期刊与 10 位作者。在 Biblioshiny 程序中，主要通过 h 指数及其衍生的 g 指数和 m 指数，以及总引用量，净发文量和开始发布时间的综合指标进行排序。

首先，期刊信息可以反映出这个研究领域的方向性。从 Top20 期刊我们可以看出，主要包括政策、商业和技术这三类。从侧面可以看出，大多数该领域的研究者可能主要是研究政策的扩散，商业里新产品、品牌的扩散以及创新技术与扩散模型。

表二：TOP10 期刊

Source	h_index	g_index	m_index	TC	NP	PY_start
Technological Forecasting and Social Change	23	37	0.56097561	1445	49	1980

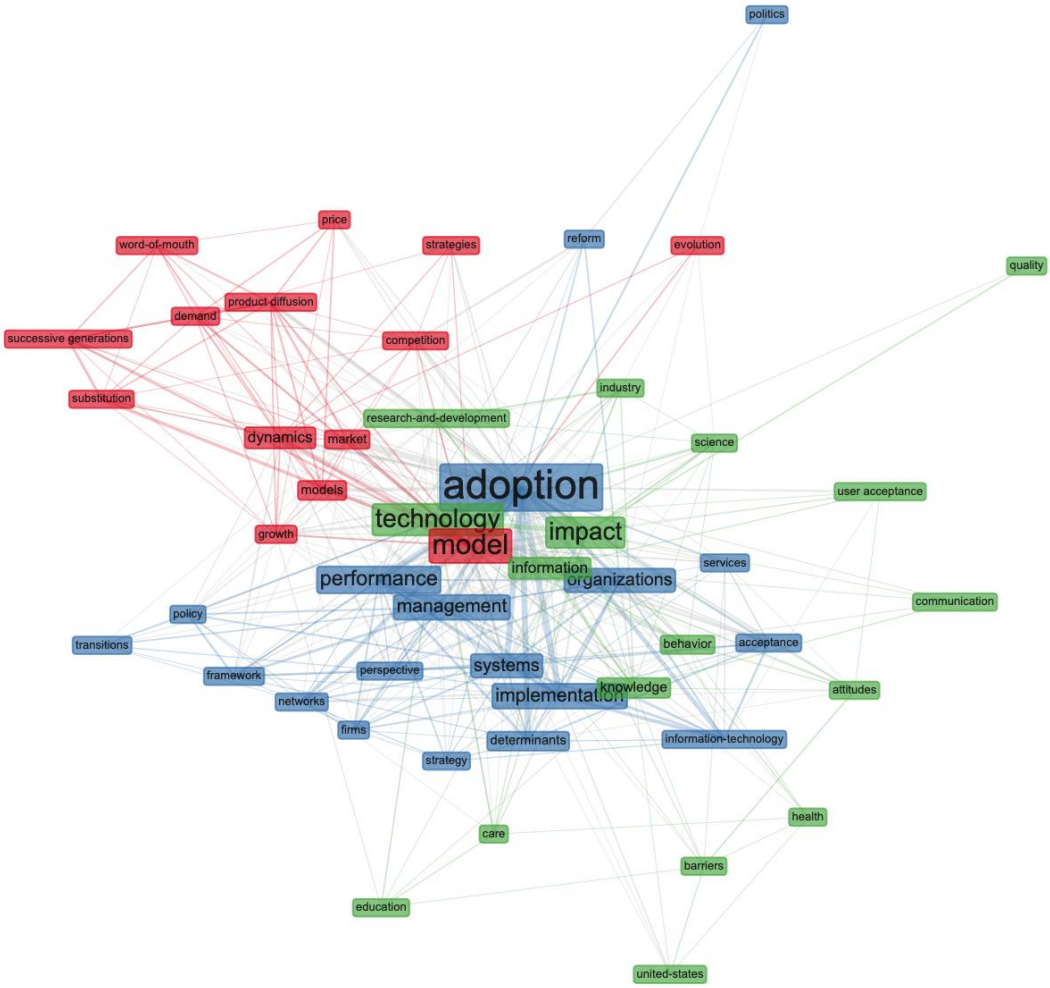
Research Policy	17	23	0.435897436	1293	23	1982
Journal of Cleaner Production	7	14	0.538461538	443	14	2008
Technovation	7	11	0.194444444	270	11	1985
Journal of Health Communication	7	10	0.304347826	236	10	1998
Journal of Scientific & Industrial Research	3	5	0.103448276	36	10	1992
Technology Analysis & Strategic Management	6	10		206	10	1998
Energy Policy	9	9	0.529411765	419	9	2004
International Journal of Technology Management	4	8	0.181818182	66	8	1999
Journal of Business Research	5	8	0.151515152	77	8	1988

表三：Top10 作者

Author	h_index	g_index	m_index	TC	NP	PY_start
Rogers EM（传播学）	8	11	0.154	810	11	1969
Mahajan V（商科）	10	10	0.227	1241	10	1977
Guseo R（商科）	8	9	0.615	134	9	2008
Brown LA（商科）	5	8	0.096	159	8	1969
Zhu XF（政治）	5	8		119	8	2014
Agnihotri K（）	2	4	0.5	16	6	2017
Kumar R	2	4	0.5	16	6	2017
Kumar V	3	6	0.103	48	6	1992
Muller E（商科）	6	6	0.143	1031	6	1979
Sharma AK（）	2	4	0.5	16	6	2017

（二） 关键词分析

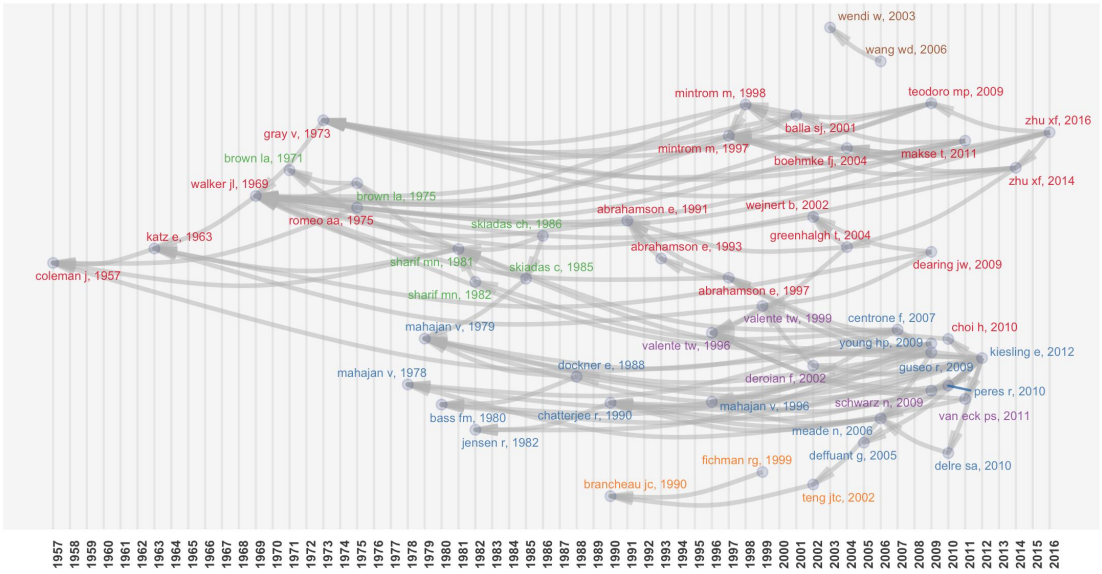
关键词共现分析可以反映出一个研究领域的主要概念



Keywords Plus	Cluster
strategy, models, word of mouth, successive generations, production diffusion, market, evolution, price, **model**, competition, **dynamics**, substitution, **growth**, demand	1
implementation, **adoption**, information—technology, organizations, perspective, **systems**, performance, policy, framework, management, transitions, reform, strategy, networks, firms, politics, acceptance, services, determinants	2
technology, user acceptance, united states, behavior, **impact**, quality, education, communication, research and development, science, **information**, knowledge, industry, care, barriers, attitudes, health	3

（三） 重要文献分析

根据历史直接引文网络分析所展示的文献历程，第一篇是来自 Coleman，Katz 和 Menzel 于 1957 年发表于 Sociometry 杂志上的关于新药物在医生群体里的扩散研究，该研究在 4 个城市中进行，并连续追踪了 15 个月的数据，揭示了该项创新扩散的持续社会过程。[] 而最后一篇则是由，从图中，我们还可以看到 6 种不同的标记颜色，代表了 6 种不同的研究路径。



1=red, 2=green, 3=blue, 4=orange, 5=purple, 6=brown

Author	Title	Year	LCS	GCS	Path
Coleman J	The diffusion of an innovation among physicians []	1957	34	633	1
Katz E	Traditions of research on the diffusion of innovation []	1963	19	200	1
Walker JL	Diffusion of innovations among American states	1969	74	1207	1
Brown LA	Empirical regularities in diffusion of innovation	1971	13	54	2
Gray V	Innovation in states - diffusion study	1973	44	560	1
Brown LA	Market and infrastructure context of adoption - spatial perspective on diffusion of innovation	1975	10	57	2
Romeo AA	Interindustry and interfirm differences in rate of diffusion of an innovation	1975	9	100	1
Mahajan V	Innovation diffusion in a dynamic potential adopter population	1978	13	141	3
Mahajan V	Innovation diffusion and new product growth-models in marketing	1979	18	178	3
Bass FM	The relationship between diffusion rates, experience curves, and demand elasticities for consumer durable technological innovations	1980	10	122	3
Sharif MN	Binomial innovation diffusion-models with dynamic potential adopter population	1981	20	71	2
Jensen R	Adoption and diffusion of an innovation of uncertain profitability	1982	15	192	3
Sharif MN	Polynomial innovation diffusion-models	1982	10	32	2
Savage RL	Diffusion research traditions and the spread of policy innovations in a federal system	1985	10	64	
Skiadas C	2 generalized rational models for forecasting innovation diffusion	1985	12	47	2
Skiadas Ch	Innovation diffusion-models expressing asymmetry and or positively or negatively influencing forces	1986	12	38	2

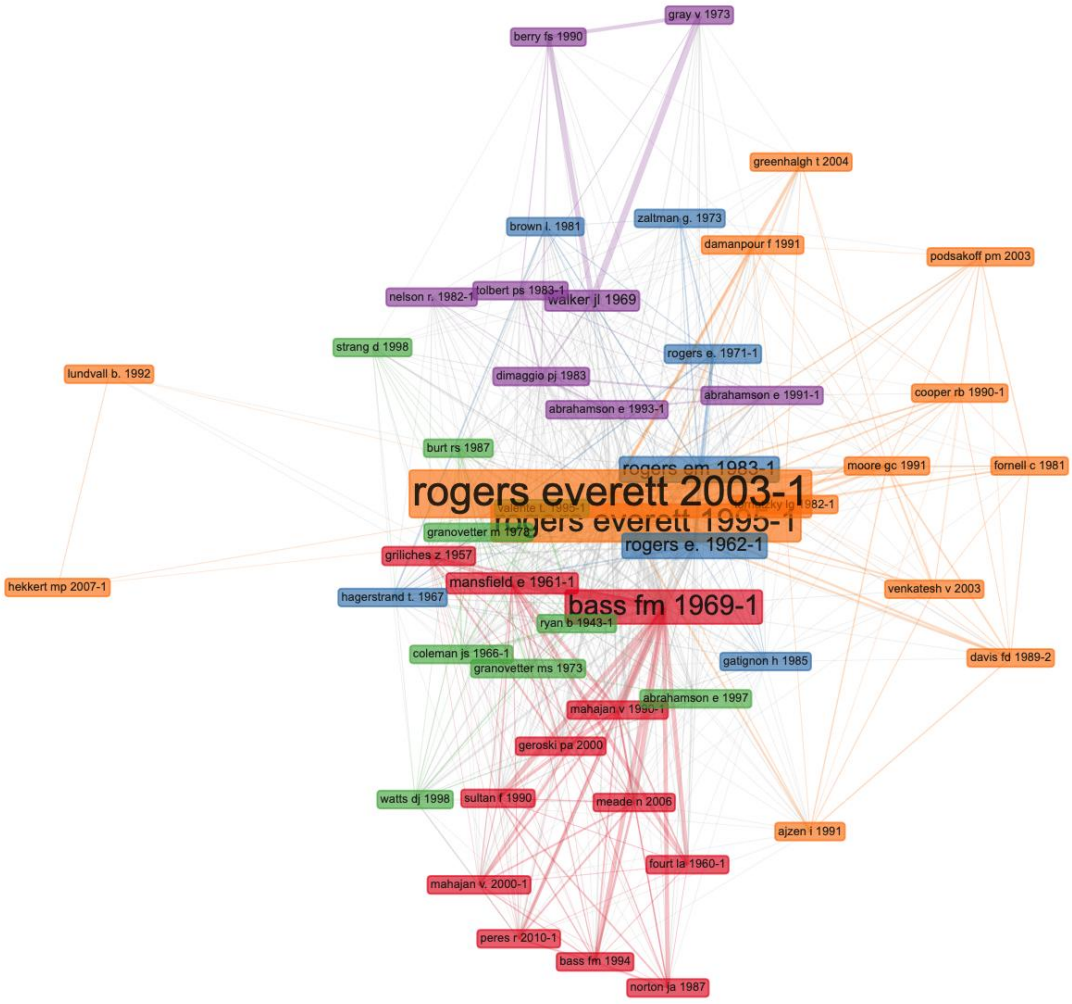
Dockner E	Optimal advertising policies for diffusion-models of new product innovation in monopolistic situations	1988	14	79	3
Brancheau JC	The adoption of spreadsheet software: testing innovation diffusion theory in the context of end-user computing	1990	11	282	4
Chatterjee R	The innovation diffusion process in a heterogeneous population - a micro-modeling approach	1990	22	187	3
Abrahamson E	Managerial fads and fashions - the diffusion and rejection of innovations	1991	32	979	1
Abrahamson E	Institutional and competitive bandwagons - using mathematical-modeling as a tool to explore innovation diffusion	1993	25	531	1
Valente TW	Social network thresholds in the diffusion of innovations	1996	25	426	5
Mahajan V	Timing, diffusion, and substitution of successive generations of technological innovations: the IBM mainframe case	1996	16	151	3
Mintrom M	Policy entrepreneurs and the diffusion of innovation	1997	25	599	1
Abrahamson E	Social network effects on the extent of innovation diffusion: a computer simulation	1997	20	363	1
Mintrom M	Policy networks and innovation diffusion: the case of state education reforms	1998	18	286	1
Fichman RG	The illusory diffusion of innovation: an examination of assimilation gaps	1999	10	275	4
Valente TW	Accelerating the diffusion of innovations using opinion leaders	1999	18	293	5
Balla SJ	Interstate professional associations and the diffusion of policy innovations	2001	9	137	1
Wejnert B	Integrating models of diffusion of innovations: a conceptual framework	2002	27	535	1
Rogers EM	Diffusion of preventive innovations	2002	13	377	
Deroian F	Formation of social networks and diffusion of innovations	2002	9	73	5
Teng JTC	Information technology innovations: general diffusion patterns and its relationships to innovation characteristics	2002	11	104	4
Wendi W	Innovation diffusion model in patch environment	2003	11	26	6
Greenhalgh T	Diffusion of innovations in service organizations: systematic review and recommendations	2004	40	3285	1
Boehmke FJ	Disentangling diffusion: the effects of social learning and economic competition on state policy innovation and expansion	2004	14	145	1
Deffuant G	An individual-based model of innovation diffusion mixing social value and individual benefit	2005	9	90	3
Meade N	Modelling and forecasting the diffusion of innovation - a 25-year review	2006	44	394	3
Wang WD	Mathematical models of innovation diffusion with stage	2006	9	24	6

	structure				
Centrone F	Demographic processes in a model of innovation diffusion with a dynamic market	2007	10	23	3
Young HP	Innovation diffusion in heterogeneous populations: contagion, social influence, and social learning	2009	12	218	3
Schwarz N	Agent-based modeling of the diffusion of environmental innovations - an empirical approach	2009	9	148	5
Dearing JW	Applying diffusion of innovation theory to intervention development	2009	10	167	1
Guseo R	Modelling a dynamic market potential: a class of automata networks for diffusion of innovations	2009	10	40	3
Teodoro MP	Bureaucratic job mobility and the diffusion of innovations	2009	9	54	
Peres R	Innovation diffusion and new product growth models: a critical review and research directions	2010	31	403	3
Delre SA	Will it spread or not? The effects of social influences and network topology on innovation diffusion	2010	18	119	3
Choi H	Role of network structure and network effects in diffusion of innovations	2010	13	76	1
Van Eck PS	Opinion leaders' role in innovation diffusion: a simulation study	2011	11	98	5
Lee YH	Adding innovation diffusion theory to the technology acceptance model: supporting employees' intentions to use e-learning systems	2011	11	156	
Makse T	The role of policy attributes in the diffusion of innovations	2011	9	89	1
Kiesling E	Agent-based simulation of innovation diffusion: a review	2012	24	185	3
Zhu XF	Mandate versus championship vertical government intervention and diffusion of innovation in public services in authoritarian china	2014	12	51	1
Zhu XF	Political mobility and dynamic diffusion of innovation: the spread of municipal pro-business administrative reform in china	2016	11	38	1

根据文献共引分析，我们可以观察该研究领域的知识基础和知识结构。从图中我们可以看到一共有 5 种颜色，代表了 5 种基础知识的聚类。

Author	Document	Year	Cluster	Betweenness	Closeness
BASS FM	10.1287/mnsc.15.5.215		1	58.93657246	0.01754386
	10.2307/1252170		1	9.103618474	0.015384615
	NEW PRODUCT DIFFUSION		1	0.751711067	0.013513514
	10.1287/mnsc.33.9.1069		1	0.186768799	0.0125
	10.2307/3172552		1	1.802472919	0.013888889
	10.1287/mksc.13.3.203		1	0.716445171	0.013157895
	10.2307/1248608		1	0.666749493	0.012820513
	10.1016/S0048-7333(99)00092-X		1	1.703075947	0.014492754
	10.2307/1911817		1	25.56224586	0.016666667
	10.2307/1905380		1	8.675108121	0.014925373
	10.1016/j.ijforecast.2006.01.005		1	2.829977488	0.014705882
	10.1016/j.ijresmar.2009.12.012		1	0.833087826	0.013333333
	DIFFUSION INNOVATION		2	25.46090089	0.018518519
	INNOVATION DIFFUSION		2	1.710496683	0.01369863
	DIFFUSION INNOVATION		2	7.77720239	0.014705882
	DIFFUSION INNOVATION		2	35.60274398	0.018518519
	INNOVATIONS ORG		2	1.278936227	0.013333333
	10.1086/209021		2	2.256474087	0.014285714
	INNOVATION DIFFUSION		2	0.698038736	0.013157895
	NETWORK MODELS DIFFU		3	2.627291796	0.014492754
	10.1086/226707		3	3.777316172	0.015151515
	10.1086/228667		3	9.197939636	0.015625
	Ryan B, 1943, RURAL SOCIOL, V8, P15		3	5.543398948	0.015625
	10.1146/annurev.soc.24.1.265		3	0.638860136	0.012820513
	10.1287/orsc.8.3.289		3	2.851065494	0.015151515
	10.1086/225469		3	2.373319163	0.014705882
	10.1038/30918		3	0.912639203	0.013333333
	MED INNOVATION DIFFU		3	3.319900344	0.014925373
	10.2307/258919		4	3.660118701	0.014084507
	10.2307/1963526		4	0.53279981	0.011764706
	10.2307/2095101		4	7.408772072	0.015384615
	10.2307/1954434		4	10.81365918	0.014084507
	10.2307/1956541		4	0.234930526	0.011627907
	10.2307/258906		4	2.644356795	0.014492754
	10.2307/2392383		4	3.979871103	0.014285714
	EVOLUTIONARY THEORY		4	0.388466051	0.012820513
	10.2307/256406		5	2.524870494	0.013513514
	DIFFUSION INNOVATION		5	123.9333508	0.02

	10.1109/TEM.1982.6447463	5	7.234215788	0.015384615
	10.1287/mnsc.36.2.123	5	0.78065107	0.012195122
	10.2307/3151312	5	0.277239571	0.011764706
	10.1287/isre.2.3.192	5	4.535465769	0.013157895
	10.1037/0021-9010.88.5.879	5	0.262505785	0.011764706
	10.1287/mnsc.35.8.982	5	0.442108475	0.011764706
	10.1016/0749-5978(91)90020-T	5	1.580129878	0.012820513
	DIFFUSION INNOVATION	5	186.0370099	0.02
	10.1016/j.techfore.2006.03.002	5	0.097674419	0.010526316
	NATL SYSTEMS INNOVAT	5	0.553816034	0.010752688
	10.1111/j.0887-378X.2004.00325.x	5	0.388323107	0.012195122
	Venkatesh V, 2003, MIS QUART, V27, P425	5	0.895307186	0.012345679



参考文献

[] Coleman, J., Katz, E., & Menzel, H. (1957). The diffusion of an innovation among physicians. *Sociometry, 20*(4), 252–270. https://doi.org/10.2307/2785979

[] Katz, E., Levin, M. L., & Hamilton, H. (1963). Traditions of research on the diffusion of innovation. *American Sociological Association, 28*(2), 237–252. https://doi.org/10.2307/2090611

[] Walker, J. L. (1969). The diffusion of innovations among the American states. *American Political Science Review, 63*(3), 880–899. https://doi.org/10.2307/1954434

[] Brown, L. A., & Cox, K. R. (1973). Empirical regularities in diffusion of innovation. Annals of the Association of American Geographers, 61(3), 551-559 https://doi.org/10.1111/j.1467-8306.1971.tb00806.x

[] Gary, V. (1973). Innovations in the States: A diffusion study. *American Political Science Review, 67*(4), 1174–1185. https://doi.org/10.2307/1956539

[] Brown, L. A. (1975). Market and infrastructure context of adoption - spatial perspective on diffusion of innovation. *Economic Geography, 51*(3), 185-216. https://doi.org/10.2307/143117

[] Romeo, A. A. (1975). Interindustry and interfirm differences in the rate of diffusion of an innovation. *The Review of Economics and Statistics, 57*(3), 311-319. https://doi.org/10.2307/1923915

[] Mahajan, V., & Peterson, R. A. (1978). Innovation diffusion in a dynamic potential adopter population. *Management Science, 24*(15), 1557–1676. https://doi.org/10.1287/mnsc.24.15.1589

[] Mahajan, V., & Muller, E. (1979). Innovation diffusion and new product growth models in marketing. *Journal of Marketing, 43*(4), 55–68. https://doi.org/10.2307/1250271

[] Bass, F. M. (1980). The relationship between diffusion rates, experience curves, and demand elasticities for consumer durable technological innovations. The Journal of Business, 53(3), 51–67. https://www.jstor.org/stable/2352211

[] Sharif, M. N., & Ramanathan, K. (1981). Binomial innovation diffusion models with dynamic potential adopter population. Technological Forecasting and Social Change, 20(1), 63-87. https://doi.org/10.1016/0040-1625(81)90041-X

[] Jensen, R. (1982). Adoption and diffusion of an innovation of uncertain profitability. *Journal of Economic Theory, 27*(1), 182-193. https://doi.org/10.1016/0022-0531(82)90021-7

[] Sharif, M. N., & Ramanathan, K. (1982). Polynomial innovation diffusion models. Technological Forecasting and Social Change, 21(4), 301–323. https://doi.org/10.1016/0040–1625(82)90043–9

[]

[] Skiadas, C. (1985). Two generalized rational models for forecasting innovation diffusion. Technological Forecasting and Social Change, 27(1), 39–61. https://doi.org/10.1016/0040–1625(85)90003–4

[] Skiadas, C. H. (1986). Innovation diffusion models expressing asymmetry and/or positively or negatively influencing forces. Technological Forecasting and Social Change, 30(4), 313–330. https://doi.org/10.1016/0040–1625(86)90030–2

[] Dockner, E., & Jorgensen, S. (1988). Optimal advertising policies for diffusion models of new product innovation in monopolistic situations. Marketing Science, 34(1), 1–137. https://doi.org/10.1287/mnsc.34.1.119

[] Brancheau, J. C., & Wetherbe, J. C. (1990). The adoption of spreadsheet software: Testing innovation diffusion theory in the context of end–user computing. Information Systems Research,

1(2), 115–225. https://doi.org/10.1287/isre.1.2.115
[] Chatterjee, R. A., & Eliashberg, J. (1990). The innovation diffusion process in a heterogeneous population: A micromodeling approach. Marketing Science, 36(9), 1011–1141. https://doi.org/10.1287/mnsc.36.9.1057
[] Abrahamson, E. (1991). Managerial fads and fashions: The diffusion and rejection of innovations. The Academy of Management Review, 16(3), 586–612. https://doi.org/10.2307/258919
[] Abrahamson, E., & Rosenkopf, L. (1993). Institutional and competitive bandwagons: Using mathematical modeling as a tool to explore innovation diffusion. The Academy of Management Review, 18(3), 487–517. https://doi.org/10.2307/258906
[] Valente, T. W. (1996). Social network thresholds in the diffusion of innovations. Social Networks, 18(1), 69–89. https://doi.org/10.1016/0378–8733(95)00256–1
[] Mahajan, V., & Muller, E. (1996). Timing, diffusion, and substitution of successive generations of technological innovations: The IBM mainframe case. Technological Forecasting and Social Change, 51(2), 109–132. https://doi.org/10.1016/0040–1625(95)00225–1
[] Mintrom, M. (1997). Policy entrepreneurs and the diffusion of innovation. American Journal of Political Science, 41(3), 738–770. https://doi.org/10.2307/2111674
[] Abrahamson, E., & Rosenkopf, L. (1997). Social network effects on the extent of innovation diffusion: A computer simulation. Organization Science, 8(3), 209–349. https://doi.org/10.1287/orsc.8.3.289
[] Mintrom, M., & Vergari, S. (1998). Policy networks and innovation diffusion: The case of State education reforms. The Journal of Politics, 60(1), https://doi.org/10.2307/2648004
[] Fichman, R. G., & Kemerer, C. F. (1999). The illusory diffusion of innovation: An examination of assimilation gaps. Information Systems Research, 10(3), 199–285. https://doi.org/10.1287/isre.10.3.255
[]
[] Balla, S. J. (2001). Interstate professional associations and the diffusion of policy innovations. American Politics Research, 29(3), 221–245. https://doi.org/10.1177%2F1532673X01293001
[] Barbara, W. (2002). Integrating models of diffusion of innovations: A conceptual framework. Annual Review of Sociology, 28(), 297–326. https://doi.org/10.1146/annurev.soc.28.110601.141051
[] Rogers, E. M. (2002). Diffusion of preventive innovations. Addictive Behaviors, 27(6), 989–993. https://doi.org/10.1016/S0306–4603(02)00300–3
[] Frederic, D. (2002). Formation of social network and diffusion of innovations. Research Policy, 31(5), 835–846. https://doi.org/10.1016/S0048–7333(01)00147–0
[] Teng, J.T.C., Grover, V., & Guttler, W. (2002). Information technology innovations: general diffusion pattern and its relationships to innovation characteristics. IEEE Transactions on Engineering Management, 49(1), 13–27. https://doi.org/10.1109/17.985744
[] Wendi, W., Fergola, P., & Tenneriello, C. (2003). Innovation diffusion model in patch environment. Applied Mathematics and Computation, 134(10), 51–67. https://doi.org/10.1016/S0096–3003(01)00268–5
[] Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. A Multidisciplinary Journal of Population Health and Health Policy, 82(4), 581–629. https://doi.org/10.1111/j.0887–378X.2004.00325.x

[] Boehmke, FJ., & Witmer, R. (2004). Disentangling diffusion: The effects of social learning and economic competition on state policy innovation and expansion. Political Research Quarterly, 57(1), 39–51. https://doi.org/10.2307/3219833
[] Deffuant, G., Huet, S., & Amblard, F. (2005). An individual–based model of innovation diffusion mixing social value and individual benefit. American Journal of Sociology, (110),4, https://doi.org/10.1086/430220
[] Meade, N., & Islam, T. (2006). Modelling and forecasting the diffusion of innovation – A 25–year review. International Journal of Forecasting, 22(3), 519–545. https://doi.org/10.1016/j.ijforecast.2006.01.005
[] Wendi, W., Fergola, P., Lombardo, S., & Mulone, G. Mathematical models of innovation diffusion with stage structure. Applied Mathematical Modelling, 30(1), 129–146. https://doi.org/10.1016/j.apm.2005.03.011
[] Centrone, F., Goia, A., & Salinelli, E. (2007). Demographic process in a model of innovation diffusion with dynamic market. Technological Forecasting and Social Change, 74(3), 247–266. https://doi.org/10.1016/j.techfore.2006.02.006
[] Young, H. P. (2009). Innovation diffusion in heterogeneous populations: Contagion, social influence and social learning. American Economic Review, 99(5), 1899–1924. DOI: 10.1257/aer.99.5.1899
[] Schwarz, N., & Ernst, A. (2009). Agent–based modeling of the diffusion of environmental innovations – An empirical approach. Technological Forecasting and Social Change, 76(4), 497–511. https://doi.org/10.1016/j.techfore.2008.03.024
[] Dearing, J. W. (2009). Applying diffusion of innovation theory to intervention development. Research on Social Work Practice, 19(5), 503–518. https://doi.org/10.1177/1049731509335569
[] Guseo, R., & Guidolin, M. (2009). Modelling a dynamic market potential: A class of automata networks for diffusion of innovations. Technological Forecasting and Social Change, 76(6), 806–820. https://doi.org/10.1016/j.techfore.2008.10.005
[] Teodoro, M. P. (2008). Bureaucratic job mobility and the diffusion of innovations. American Journal of Political Science, 53(1), 175–189. https://doi.org/10.1111/j.1540–5907.2008.00364.x
[] Peres, R., Muller, E., & Mahajan, V. (2010). Innovation diffusion and new product growth models: A critical review and research. International Journal of Research in Marketing, 27(2), 91–106. https://doi.org/10.1016/j.ijresmar.2009.12.012
[] Delre, S. A., Wander, J., Tammo, H. A. B., & Marco, A. J. (2010). Will it spread or not? The effects of social influences and network topology on innovation diffusion. The Journal of Product Innovation Management, 27(2), 267–282. https://doi.org/10.1111/j.1540–5885.2010.00714.x
[] Choi, H., Kim, SH., & Lee, J. (2010). Role of network structure and network effects in diffusion of innovations. Industrial Marketing Management, 39(1), 170–177. https://doi.org/10.1016/j.indmarman.2008.08.006
[] van Eck, P. S., Jager, W., & Leeflang, P.S.H. (2011). Opinion leaders' role in innovation diffusion: A simulation study. The Journal of Product Innovation Management, 28(2), 187–203. https://doi.org/10.1111/j.1540–5885.2011.00791.x
[]

[] Makse, T., & Volden, C. (2011). The role of policy attributes in the diffusion of innovations. The Journal of Politics, 73(1), https://doi.org/10.1017/S0022381610000903

[] Kiesling, E., Gunther, M., Stummer, C., & Wakolbinger, LM. (2012). Agent-based simulation of innovation diffusion: a review. Central European Journal of Operations Research, 20(), 183-230. https://link.springer.com/article/10.1007/s10100-011-0210-y

[] Zhu, XF. (2014). Mandate versus championship: Vertical government intervention and diffusion of innovation in public services in authoritarian China. Public Management Review, 16(1), 117-139. https://doi.org/10.1080/14719037.2013.798028

[] Zhu, XF., & Zhang, YL. (2016). Political mobility and dynamic diffusion of innovation: the spread of municipal pro-business administrative reform in China. *Journal of Public Administration Research and Theory, 26*(3), 535-551. https://doi.org/10.1093/jopart/muv025