Evaluating the business impacts of social media use with System Dynamics and Agent-Based Modeling

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Evaluating the Business Impacts of Social Media Use with System Dynamics and Agent-Based Modeling:
A Literature Review

Olli Pirttilä, Granite Partners Ltd., Tampere, Finland
Hannu Kärkkäinen, Tampere University of Technology, Tampere, Finland
Jari J. Jussila, Tampere University of Technology, Tampere, Finland

ABSTRACT

Social media has been widely adopted as a useful business tool, especially in the domain of business to consumer marketing. However, the deployment of social media tools to business processes is hindered by the lack of concrete indicators of the effects its use has on the business process. Computer based modeling has been widely used to simulate and predict business effects in other streams of study, but relatively little in the evaluation of social media impacts. This paper argues that System Dynamics and Agent-Based Modeling have been and should be utilized in measuring social media and its impacts in business context in general, as well as in the context of business ecosystems. The authors review the current state of the use of these simulation methods in the evaluation of social media business impacts by conducting a systematic literature review.

KEYWORDS

Agent-Based Modeling, Agent-Based Simulation, Business Ecosystems, Computer-Based Modeling, Impact Evaluation, Measurement, Social Media, System Dynamics Modeling, Web 2.0

INTRODUCTION

There is a body of existing scientific research on the effects of social media use in a business setting. For example, in marketing literature the biggest obstacle in deploying social media to business processes is often viewed to be the difficulty to demonstrate its effects and return on investment. According to Fisher (2009) the lack of indicators of potential benefits and expected return on investment slows down or hinders the adoption of social media as a part of a company's marketing strategy. In addition, the ability to show measurable effects in other business functions would be beneficial. According to Jussila et al. (2014), the adoption of social media in business-to-business companies is restricted by the difficulty to show and assess the business benefits. They state that effective means and models to measure and demonstrate the benefits of social media use would be beneficial. Also Aral, Dellarocas, and Godes (2013) emphasize in their framework for the research of social media that the measuring of the effects of social media use on the individual level, platform level and company level is ranked as one of the major goals for new social media research.

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This paper aims to answer how system dynamics and agent-based modeling has been used in the past to measure the effects of social media use and what possibilities could it offer for measuring social media and effects of its use in business ecosystems. Of the possible modeling methods, agent-based modeling (ABM) and system dynamics modeling (SDM) have been chosen for this review, because they are especially well suited for modeling complex social systems, and are quite well established methods for research in the scientific community. By carrying out a systematic literature review on the subject, we aim to give a comprehensive picture of the current state of modeling applications that provide various solutions to the challenges posed by the measuring and demonstrating the business effects of social media use by traditional methods.

The main research problem of this review is ”Do agent-based and system dynamics modeling offer useful ways to measure social media and effects of its use in a business context?”. This paper aims to resolve this problem by answering these research questions:

- **RQ1:** In which ways have ABM and SDM been used to measure the impacts of social media use?
- **RQ2:** Why have ABM and SDM been used and why should they be used in the evaluation of social media impacts?
- **RQ3:** Based on found applications, what are the direct or indirect business implications of using ABM or SDM in measuring the impacts of social media?

SOCIAL MEDIA AND ITS BUSINESS USE

In order to define social media accurately, one has to define the terms “web 2.0” and” User Generated Content”. Web 2.0 is a term first introduced by Tim O’Reilly in 2004 that describes the new approach of users and developers in using www-technology (O’Reilly, 2009). In the new approach the content and applications of the World Wide Web are no longer made only by individual developers. Instead, the content is constantly generated and modified communally by both the developers and users. (Kaplan & Haenlein, 2010) The term “web 2.0” includes open, interactive and communal applications that support the aforementioned communal nature of the World Wide Web. Web 2.0 applications support the formation of informal user communities and create a frame that allows the sharing of ideas and information by enabling effective creation, modification, spreading and sharing of informal information (Constantinides & Fountain, 2008).

User Generated Content (UGC) is the wide variety of publicly accessible information that exists on web 2.0 applications, and is generated by the users of that application (Kaplan & Haenlein, 2010). By combining the definitions of UGC and web 2.0, one can give a broader definition for the term “social media”. Social Media is defined as internet-based applications that utilize web 2.0 technology and principles, and enable the creation and sharing of User Generated Content (Kaplan & Haenlein, 2010).

In spoken language the term social media is often affiliated only with social networking and micro blogging services, but in fact the term includes a broader set of application. Also, the terms “social media” and “web 2.0” are often used as synonyms, but in reality they mean different things. Social media is a very broad term that includes a wide variety of applications, in which the social interactions and user participation are key features.

Lietsala and Sirkkunen (2008) propose that social media should be used as an umbrella term, under which different practices and applications can be categorized. They state that established social media practices or application are, for example, blogging, social networking services and wikis. Kaplan and Haenlain (2010) similarly divide social media applications into six different categories according to the needed social presence and information richness. The categories are: blogs, social networking services, virtual social worlds and collaborative projects. These social media applications can be used to gain measurable business benefits, and develop social business ecosystems. For example, the social business ecosystem of a company can consist of open source communities, inter-organizational social networks, as well as customer and supplier communities. Using these aforementioned social

media tools has been demonstrated to open new possibilities, because they enhance communication, interaction, learning and collaboration (Jussila, 2015). However, these novel tools and business ecosystems are often very abstract and complex social systems, and thus, their business effects and return on investment is hard to measure and demonstrate.

SYSTEM DYNAMICS AND AGENT-BASED MODELING

With agent-based modeling one can simulate social systems, which often are formed as a sum of complex social procedures and interactions (Bonabeau, 2002). On the other hand, system dynamics modeling offers a system level perspective on the behavior and forming of trends in the social system. Agent-based and system dynamics modeling also complement each other, because agent-based modeling offers a way to investigate individual actors in detail, whereas system dynamics offers a way to examine the system as a whole. (Wang & Moon, 2013)

Agent-Based Modeling

Agent based-modeling (ABM) is a modeling method that enables the simulation of complex systems that consists of autonomous agents that interact with each other. The interaction between agents is defined according to certain simple rules and procedures that are assigned to them. By simulating the individual actions of different agents one can model the complexity of a social system and the effect that the individual actions have on the system as a whole. (Macal & North, 2010; Janssen, 2005) At its simplest, an agent-based model consists of agents and relations between those agents. In more complex models one can include network and learning algorithms that more accurately describe the learning and unpredictable behavior of the agents. (Bonabeau, 2002)

System Dynamics Modeling

System dynamics modeling (SDM) is a computer based modeling method that is based on a system dynamics view. The goal is to understand complex, non-linear, problems with the help of systems thinking. System dynamics models are based on the causal nature of the problems and on the wholesome effect that different factors have on the system as a whole. Modeling can be done in a qualitative or quantitative level. On the qualitative level one examines, for example, effect-tables or causal loops. On the quantitative level one examines, among others, stock-flow tables. (IGI Global Dictionary, 2014; Sterman, 2002; System Dynamics Society, 2014) The goal of system dynamics models is to create a model that holds equations that describe the system, and then understand the dynamic behavior of the system by simulating the working system with the model (Forrester, 1994).

RESEARCH APPROACH

The research method of this paper is a systematic literature review. The research material has been gathered by conducting an article search from the following international journal databases: Elsevier Science Direct, Scopus, EBSCOhost (Academic Search Elite & Business Source Complete), ABI Inform (Business Suite) – ProQuest, ACM Digital Library, IEEE Xplore Digital Library, Emerald Insight. The search parameter is constructed in a way that the results consist of the intersection of the social media topic set and modeling topic set. The search parameters were searched from the title, abstract and keywords of the database articles. Each result contains at least one search keyword from the social media topic set and one from the modeling topic set. Social media topic set keywords were: *social media, web 2.0, enterprise 2.0, online community, online social network, virtual world, crowdsourcing, social platform, social office tool, blog, microblog, online collaboration.* Modeling topic set keywords were: *agent-based modelling, agent based modelling, agent-based simulation, agent*

based simulation, system dynamic, system dynamics, system dynamic modelling, system dynamics modelling, system dynamic simulation, hybrid model, hybrid simulation model.

The scope of the search is confined to include scientific journals and conference papers. Including conference papers is justified, because the most high-quality and novel research about the modeling topic is often published especially on modeling and simulation conferences. Conference papers also offer quite novel information due to their relatively short review and publishing cycle. The search is also confined to papers published after the year 2000. This is due to the fact that social media related research is unlikely to be found before the year 2005, when social media and web 2.0 became established, and first well known social media applications became common (Lietsala & Sirkkunen, 2008).

The backward and forward references of these articles were also examined with Scopus and Thomson Reuters Web of Science to find more relevant material on the subject. Based on this search, 2 additional articles were identified from backward references. The titles and abstracts of articles published after 2000 in the System Dynamics Review and Journal of Artificial Societies and Social Simulation were also examined. No additional material was found from these journals.

The identified material was narrowed down according to two exclusion/inclusion criteria:

- **C1:** The article has to discuss the agent-based or system dynamics modeling of utilization of social media or the effects of using social media in general or the modeling of a specific social media application in a business setting or a setting that is applicable to business also. Furthermore, we included only papers that present a model created by authors, not e.g. generic examples of modeling or reviews of others' models.
- **C2:** The article must be a scientifically peer-reviewed publication.

The database searches of this research were carried out systematically from multiple databases with broad, non-restricting search parameters. The results yielded 101 publications that were narrowed down to 20 according to the inclusion/exclusion criteria C1 and C2. The distribution of these publications with respect to journal or conference is given in Table 1.

6 publications from the found publications were published in a scientific journal and the rest were published in conference proceedings or books edited from conference papers. Most of the found scientific journal articles have been published in a journal with Thompson Reuters Journal Impact Factor. All studied conference papers were published in conference proceedings that are organized by Institute of Electrical and Electronics Engineers (IEEE) or some other well-known and respected publications organizations.

RESULTS

In the systematic literature review, of the overall 20 articles found in the literature review, 10 described direct business implications and 10 entailed indirect or potential business implications of using ABM and SDM.

Altogether 9 different types of applications of ABM and SDM were identified from the publications discovered in the systematic literature review. The found applications range from modeling individual user behavior to examining network formation. The found applications are:

1. Examining effective ways to encourage the use of social network services (articles 4, 6 & 11)
2. Examining online community networks and collaboration (article 1)
3. Modeling online network formation (articles 17, 18 & 19)
4. Modeling of online social network dynamics (articles 20)
5. Modeling the diffusion of information in social media (articles 15 & 16)

Table 1. Distribution of publications

Journals	Publications
Government Information Quarterly	1
Journal of Advanced Computational Intelligence and Intelligent Informatics	1
System Dynamics Review	1
Computational Economics	1
Computational and Mathematical Organization Theory	1
European Journal of Operational Research	1
Conferences	**Publications**
World Congress on Social Simulation	1
IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology	4
Hawaii International Conference on System Science (HICSS)	1
Lecture Notes in Computer Science	3
Annual International Digital Government Research Conference	1
International Conference on Autonomous Agents and Multiagent Systems (AAMAS)	1
Emerging Intelligent Data and Web Technologies (EIDWT)	1
The International Conference on Social Computing, Behavioral-Cultural Modeling, and Prediction (SBP 2015) (published later in book / Springer International Publishing Switzerland)	1
IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining	1

6. Modeling the effects of online word of mouth to consumer behavior (articles 2 & 3)
7. Modeling opinion formation of stakeholders in social media to understand & predict social behavior. (article 14)
8. Examining social media to support decision making in policy making (5, 7, 12 & 13 articles)
9. Modeling future trends in social media conversations (article 10)

From the above applications one could underline two broad themes. Applications 1-4 deal with understanding online networks and dynamics that lie within them by, for example, modeling the drivers that affect user behavior in the social media service or tool in question. The general goal of these applications was to understand the internal mechanisms of the social media services or tools, and to identify ways that could enhance the use of these tools. By understanding, firstly, how online networks were formed and which factors increase cohesion in the online network or community (applications 3 & 4), and secondly, how agents interacted within that network (applications 1 & 2), the studies created useful insight and measured the effectiveness of online social networking tools in business use. In addition to measuring the effects of the tool, one could also test different scenarios and methods that aimed to encourage the use of these tools and make it more effective.

Applications 5-9 on the other hand deal with understanding how social media affects various types of information flow- related phenomena by, for example, examining how information was diffused in social media, and how that affected opinion formation or consumer behavior. The goal of these applications, in general, was to simulate social media phenomena in order to develop useful insights on how the social media information flows affected real world indicators and impacted, for example, decision making. Applications 5 & 6 deal with the diffusion of information in social media and its

impacts in a business context and other societal contexts. Applications 7 & 9 deals with understanding and predicting social behavior, by modeling how opinions emerged, diffused and gained momentum. Application 8 (with 4 different articles) models the formation of opinions and opinion groups in social media to better understand how policy makers' decisions impact different stakeholders.

By analyzing these applications, several direct implications for business that were described in the articles were discovered. Also indirect business implications were discovered that weren't described directly in the articles, but were implied or deductible from the articles. Ten of the articles found in the systematic literature review described ABM or SDM applications that presented direct business implications. The applications that had direct business implications and the different empirical data they rely on are presented in Table 2.

The underlying theme of all the direct business implications stated in table 2 was the examination and forecasting of human behavior in complex social and business ecosystems. Almost all of the described applications relied on empirical data and are implemented using ABM. The stated benefits of using computer based simulation and modeling included the facilitated understanding and additional insight they brought to the comprehension of business ecosystems and the actions of their individual actors. By understanding and forecasting the inner systemic structure and operation of these ecosystems one could make more informed business decisions, as well as better understand and even forecast their short- and long-term impacts. Often the forecasts and analyses could also be made without having to extrapolate from actual history data. As seen in the found articles, the models could be calibrated with openly available empirical data, and this enabled to forecast ecosystem behavior without having to collect vast amounts of data first.

10 of the found articles had indirect or potential business implications that weren't addressed as such in the articles, but could be applied to modeling the complex systemic impacts of social media in a business context. The applications that had indirect or potential business implications are presented in table 3.

Most of the indirect or potential business implications stated in table 3 deal with the better understanding of complex social systems or business ecosystems. The recognized business implications included forecasting market reactions to public policy changes, understanding the mechanisms of information resonance in marketing strategy formation, as well as the understanding the information diffusion in social media communities for marketing purposes.

DISCUSSION AND CONCLUSION

The found applications give a good overall answer to the first research question (RQ1). The two major themes that are present in the found applications coincide well with the general qualities and benefits that are usually associated with ABM and SDM. Of the discovered articles, only 3 used SDM, all others utilized ABM. The fact that clear majority of the found applications utilizes ABM instead of SDM is not surprising if one considers that ABM is especially well suited to model complex social systems. The lack of SDM applications however is a noteworthy result, because it is the more established method of the two, and yet hasn't been utilized that much in social media research.

Regarding the differences of the modeling methods, Otto & Simon (2008) point out that system dynamics modeling can describe the properties of causal links and essential features of the whole system with a high level perspective. The difference between ABM and SDM is that SDM rarely includes modeling that takes into account the individual and random actions of every single agent in the system. Instead SDM explains the working of the network as a whole system. Most of the found ABM applications imply that the model gives a micro level perspective on the subject in addition to the macro level perspective that other more traditional empirical studies and models offer.

Regarding the second research question (RQ2), we were able to draw three major arguments why simulation approaches were used in studied articles and should be used in general.

Table 2. Applications of modeling and their direct business implications

Ref. #	Publication	Method	Application of modeling	Empirical data	Direct business implications described in the article
1	Otto, P., & Simon, M. (2008). Dynamic perspectives on social characteristics and sustainability in online community networks.	SDM	Examining online community networks and collaboration	User data from online encyclopedia Wikipedia.	Experimentation with simulations can provide useful insight to manage an online community network effectively.
2	Okada, I. (2012). Relationship between Online Word-of-Mouth Communication and Consumer Behavior.	ABM	Modeling the effects of online word of mouth to consumer behaviour	Nikkei Institute of Industries and Consumption (2000) - Data and Analysis from Consumers' Life Style and Buying Trends	Forecasting customer behaviour and markets by using an ABM and selecting most effective online WOM strategies
3	Okada, I. ., & Yamamoto, H. (2011). Effects of information diffusion in online word-of-mouth communication among consumers.	ABM	Modeling the effects of online word of mouth to consumer behaviour	Online WOM communication model, with parameters based on empirical data (AISAS model & Nikkei Institute of Industries and Consumption (2000) - Data from Consumers' Life Style and Buying Trends	Forecasting customer behaviour and markets by using an ABM and selecting most effective e-WOM strategies
4	Toriumi, F. ., Yamamoto, H. ., & Okada, I. (2013). Effects of controllable facilitators on social media: Simulation analysis using Generalized Metanorms Games.	ABM	Examining effective ways to encourage the use of social network services	-	Understanding ways to promote cooperation with ABM is beneficial when social media managers make SM policies and encourage the use of such media.
5	Sobkowicz, P., Kaschesky, M., & Bouchard, G. (2012 b) . Opinion mining in social media: Modeling, simulating, and forecasting political opinions in the web.	ABM	Examining social media to support decision making in policy making	Social media content analysis of large set of online forums, blogs or other publicly available text streams (opinion detection & sentiment analysis)	Following and forecasting online opinion formation in real time on, for example, open source communities can offer useful insight into decision & policy making
6	Toriumi, F., & Ishii, K. (2010). Simulation of encouragement methods for sns based on user behavior model.	ABM	Examining effective ways to encourage the use of social network services	Based on examination of 1136 different SNS's (with 58410 users in total).	Understanding ways to promote cooperation and utilization of user-limited SNS with ABM can offer useful encouragement methods.
7	Kaschesky, M., Sobkowicz, P., & Bouchard, G. (2011). Opinion Mining in Social Media: Modeling, Simulating, and Visualizing Political Opinion Formation in the Web.	ABM	Examining social media to support decision making in government policy making	Content analysis of social media and sociophysical system modeling (natural language processing & semantic web approaches)	Following and forecasting online opinion formation in real time on, for example, open source communities can offer useful insight into decision & policy making
8	Jiang, G., Tadikamalla, P. R., Shang, J., & Zhao, L. (2016). Impacts of knowledge on online brand success: an agent-based model for online market share enhancement.	ABM	Examining evolution process of market share for multiple brands competing online	Market share of six brands from real-world data compared to market share of brands from simulation	Innovativeness, brand image, self-perceived utility and electronic word of mouth all have significant effect on on- line shoppers' decisions and on brands' market performance

continued on following page

Table 2. Continued

Ref. #	Publication	Method	Application of modeling	Empirical data	Direct business implications described in the article
9	Nararatwong, R., Legaspi, R., Okada, H., & Maruyama, H. (2015). A Novel Mental State Model of Social Perception of Brand Crisis from an Entertainment Perspective.	ABM	Modeling perception states and transitions in the event of brand crisis	-	Predicting social perception changes enables marketers to adjust their communication strategies to ensure positive perception at the end of brand crisis
10	Attema, T., van Maanen, P. P., & Meeuwissen, E. (2015). Development and Evaluation of Multi-Agent Models Predicting Twitter Trends in Multiple Domains	ABM	Modeling future trends in Twitter conversations (number of tweets and its set of subtopics)	31 134 bankin tweets and 13 124 universities tweets	Organizations can extend their social media monitoring capabilities and thus become more pro-active and less reactive

First, the simulation approaches were found to take into account the dynamic nature of social interactions in the evaluation of social media impacts in various different ways that traditional approaches, such as survey-based statistical methods or case studies used in the impact evaluations do not enable. Traditional methods and related algorithms are not generally able to handle well the complex and sometimes chaotic behaviour that is derived from relatively simple interactions of individual agents (e.g. consumers). These interactions may lead to unexpected and often counter-intuitive impacts, realized over time, from e.g. social media marketing and word-of-mouth campaigns (e.g. Okada & Yamato 2011; Okada 2012), which again, lead to consumer opinion formation about products and finally to purchasing decisions often in quite unexpected ways.

Second, traditional methods are considered ill-suited to capture changes over time and during measurement. For instance, with surveys the data is captured at fixed time intervals, often a single time interval, and they are unable to capture, for instance, how the purchasing behavior of agents (e.g. consumers) changes over time and is influenced by other agents (e.g. friends of the consumers). In comparison, in the analysed ABM simulation models, for example, new actors (agents) could be added during the simulation and the network and relationships linking the actors (individuals, organizations, etc.) could evolve over time, making use of different rules and patterns based on empirical data (e.g. Toriumi & Ishii 2010; Sobkowicz et al. 2012b) as well as theoretical models (e.g. Okada & Yamato 2011; Okada 2012).

Third, by making of use of the increased computational power of computers simulation models can be built and infused with empirical data collected from web and social media that make it fairly easy and cost effective to observe dynamic behavior, whereas with using traditional methods (e.g. surveys or interviews) the cost and difficulty of making large-scale observations of dynamic behavior would be enormous (Kaschesky et al. 2011).

The systematic literature review revealed both direct and indirect business implications of using ABM and SDM to model the use of social media. For answering the third research question (RQ3), these implications give a good overview of the business potential of the methods based on current literature.

On the basis of this study, it seems that the use of computer based modeling has significant potential in social media related business research and measuring the effects of social media use.

Table 3. Applications of modeling and their indirect / potential business implications

Ref. #	Publication	Method	Application of modeling	Empirical data	Indirect/potential business implications
11	Toriumi, F., Yamamoto, H., & Okada, I. (2012). Why Do People Use Social Media? Agent-Based Simulation and Population Dynamics Analysis of the Evolution of Cooperation in Social Media.	ABM	Examining effective ways to encourage the use of social network services	-	ABM can help to determine efficient ways to promote cooperation and content creation in enterprise SM use.
12	Boero, R. ., Ferro, E. ., Osella, M. ., Charalabidis, Y. ., & Loukis, E. (2012). Policy intelligence in the era of social computing: Towards a cross-policy decision support system.	SDM	Examining social media to support decision making in policy making	Engagement data collected from social media through public APIs and PADGETS system user inputs.	SDM can be used to simulate different market acceptance scenarios and their outcomes.
13	Charalabidis, Y. ., Gionis, G. ., Ferro, E. ., & Loukis, E. (2010). Towards a systematic exploitation of web 2.0 and simulation modeling tools in public policy process.	SDM	Examining social media to support decision making in policy making	Data collected from social media through public APIs	Simulations can be used to forecast different market reactions to policy changes.
14	Sobkowicz, P. ., Kaschesky, M. ., & Bouchard, G. (2012 a). Opinion formation in the social web: Agent-based simulations of opinion convergence and divergence.	ABM	Modelling opinion formation of stakeholders in social media to understand & predict social behavior.	-	ABM can help understand social behaviour and consensus formation in the social web, which has applications in commercial marketing applications
15	Ishikawa, T. (2012). The Mechanism of Information Resonance in Social Media.	ABM	Modeling the diffusion of information in social media	Adaptive Network Model based on empirical data of information resonance in Twitter about the 2009 post-election protests in Iran.	Understanding the mechanisms of information resonance in social media is beneficial for marketing strategy formation
16	Ishikawa, T. (2010). The Effect of Transitive Linking on Information Diffusion in Dynamic Acquaintance Networks.	ABM	Modeling the diffusion of information in social media	-	Understanding information diffusion in social media with ABM can offer insight into social media marketing applications.
17	Ackland, R., & Shorish, J. (2009). Network Formation in the Political Blogosphere: An Application of Agent Based Simulation and e-Research Tools.	ABM	Modeling online network formation	Public 1 day snapshot of 1500 political blogs and their hyperlinks. Private dataset of post made by 40 influential political bloggers.	Understanding and forecasting link formation in the blogosphere with ABM can offer insights into content marketing strategy making.
18	Abbas, S. M. A. (2013) . An agent-based model of the development of friendship links within Facebook.	ABM	Modeling online network formation	Anonymous dataset of 769 Facebook users from Caltech University	Understanding network formation in OSNs with ABM can offer insights into the utilization of enterprise OSNs.
19	Abbas, S. M. A. (2013) . Homophily, popularity and randomness: Modelling growth of online social network.	ABM	Modeling online network formation	Anonymous dataset of 6575 Facebook users from Princeton University	Understanding network formation in OSNs with ABM can offer insights into the utilization of enterprise OSNs.
20	Makinde, O. W. (2013). Social Network Message Credibility: An Agent-Based Modelling Approach.	ABM	Modeling of Online Social Network dynamics	-	Understanding peer behaviour in OSNs with ABM can offer insights into user actions and making an Enterprise OSN more secure and credible.

FUTURE RESEARCH AND LIMITATIONS

Further exploration and analyses of the discovered benefits of computer based modeling would be helpful in determining the best ways to utilize these novel methods and justify their use. As a result of this review, there are several issues that should be addressed in future research on the evaluation of social media impacts by simulation: overall, due to the provided benefits of ABM and SDM to better understanding of social media impacts, and the relatively small amount of existing found research, first, there is a clear need for more research on social media impacts in various business contexts using ABM or SDM. The possibilities of SDM use in this context are currently especially little researched and analysed. Second, in these studies, one should aim to create concrete measures and indicators for business impacts or benefits of social media use.

Considering the limitations of this study, we were not able to find, at the time of this review, yet, a very large number of applications of studied computer-based modeling approaches in the modeling of social media impacts for business. Thus, there might exist a broad variety of other application areas of modeling which have not been made use of. This issue should be revisited along with the increase of such research.

REFERENCES

Abbas, S. M. A. (2013). An agent-based model of the development of friendship links within Facebook. *Computational & Mathematical Organization Theory*, *19*(2), 232–252. doi:10.1007/s10588-013-9156-z

Abbas, S. M. A. (2013). Homophily, popularity and randomness: Modelling growth of online social network. Proceedings of the 12th International Conference on Autonomous Agents and Multiagent Systems 2013 (Vol. 1, pp. 135–142). AAMAS. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84899046699&partnerID=40&md5=55518be889b978a404c30a11081cfb58

Ackland, R., & Shorish, J. (2009). Network Formation in the Political Blogosphere: An Application of Agent Based Simulation and e-Research Tools. *Computational Economics*, *34*(4), 383–398. doi:10.1007/s10614-009-9173-7

Aral, S., Dellarocas, C., & Godes, D. (2013). Introduction to the special issue-social media and business transformation: A framework for research. *Information Systems Research*, *24*(1), 3–13. doi:10.1287/isre.1120.0470

Attema, T., van Maanen, P.-P., & Meeuwissen, E. (2015). Development and Evaluation of Multi-Agent Models Predicting Twitter Trends in Multiple Domains. *Proceedings of the 2015 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining '15* (pp. 1133–1140). ACM. Retrieved from http://dl.acm.org/citation.cfm?id=2808858

Boero, R., Ferro, E., Osella, M., Charalabidis, Y., & Loukis, E. (2012). Policy intelligence in the era of social computing: Towards a cross-policy decision support system. In The Semantic Web, LNCS (Vol. 7117, pp. 217–228.

Bonabeau, E. (2002). Agent-based modeling: Methods and techniques for simulating human systems. *Proceedings of the National Academy of Sciences of the United States of America*, *99*(Suppl. 3), 7280–7287. doi:10.1073/pnas.082080899 PMID:12011407

Charalabidis, Y., Gionis, G., Ferro, E., & Loukis, E. (2010). Towards a systematic exploitation of web 2.0 and simulation modeling tools in public policy process. In Electronic Participation, LNCS (Vol. 6229, pp. 1–12).

Constantinides, E., & Fountain, S. J. (2008). Web 2.0: Conceptual foundations and marketing issues. *Journal of Direct*. *Data and Digital Marketing Practice*, *9*(3), 231–244. doi:10.1057/palgrave.dddmp.4350098

Fisher, T. (2009). ROI in social media: A look at the arguments. *Journal of Database Marketing & Customer Strategy Management*, *16*(3), 189–195. doi:10.1057/dbm.2009.16

Forrester, J. W. (1994). System dynamics, systems thinking, and soft OR. *System Dynamics Review*, *10*(2–3), 245–256. doi:10.1002/sdr.4260100211

Global Dictionary, I. G. I. (2014). System dynamics modelling. Retrieved from http://www.igi-global.com/dictionary/system-dynamics-modelling/29052

Ishikawa, T. (2010). The Effect of Transitive Linking on Information Diffusion in Dynamic Acquaintance Networks. *Proceedings of the 2010 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT)* (Vol. 3, pp. 61–66). doi:10.1109/WI-IAT.2010.99

Ishikawa, T. (2012). The Mechanism of Information Resonance in Social Media. *Proceedings of the 2012 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology (WI-IAT)* (Vol. 1, pp. 509–513). doi:10.1109/WI-IAT.2012.136

Janssen, M. A. (2005). Agent-based modelling. In *Modelling in Ecological Economics* (pp. 155–172).

Jiang, G., Tadikamalla, P. R., Shang, J., & Zhao, L. (2016). Impacts of knowledge on online brand success: An agent-based model for online market share enhancement. *European Journal of Operational Research*, *248*(3), 1093–1103. doi:10.1016/j.ejor.2015.07.051

Jussila, J. (2015). Social Media in Business-to-Business Companies' Innovation. *Tampereen Teknillinen Yliopisto.* Julkaisu-Tampere University of Technology. Retrieved from http://dspace.cc.tut.fi/dpub/handle/123456789/23470

Jussila, J. J., Kärkkäinen, H., & Aramo-Immonen, H. (2014). Social media utilization in business-to-business relationships of technology industry firms. *Computers in Human Behavior*, *30*, 606–613. doi:10.1016/j.chb.2013.07.047

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons*, *53*(1), 59–68. doi:10.1016/j.bushor.2009.09.003

Kaschesky, M., Sobkowicz, P., & Bouchard, G. (2011). Opinion Mining in Social Media: Modeling, Simulating, and Visualizing Political Opinion Formation in the Web. *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times* (pp. 317–326). New York, NY, USA: ACM. http://doi.org/ doi:10.1145/2037556.2037607

Lietsala, K., & Sirkkunen, E. (2008). Social media. Introduction to the tools and processes of participatory economy.

Macal, C. M., & North, M. J. (2010). Tutorial on agent-based modelling and simulation. *Journal of Simulation*, *4*(3), 151–162. doi:10.1057/jos.2010.3

Makinde, O. W. (2013). Social Network Message Credibility: An Agent-Based Modelling Approach. *Proceedings of the 2013 Fourth International Conference on Emerging Intelligent Data and Web Technologies (EIDWT)* (pp. 597–602).

O'Reilly, T. (2009). *What is web 2.0*. O'Reilly Media, Inc.

Okada, I. (2012). Relationship between Online Word-of-Mouth Communication and Consumer Behavior. *Proceedings of the 2012 45th Hawaii International Conference on System Science (HICSS)* (pp. 1807–1813). http://doi.org/ doi:10.1109/HICSS.2012.500

Okada, I., & Yamamoto, H. (2011). Effects of information diffusion in online word-of-mouth communication among consumers. *Journal of Advanced Computational Intelligence and Intelligent Informatics*, *15*(2), 197–203.

Otto, P., & Simon, M. (2008, Fall). Dynamic perspectives on social characteristics and sustainability in online community networks. *System Dynamics Review*, *24*(3), 321–347. doi:10.1002/sdr.403

Sobkowicz, P., Kaschesky, M., & Bouchard, G. (2012). Opinion formation in the social web: Agent-based simulations of opinion convergence and divergence. In Agents and Data Mining Interaction LNAI (Vol. 7103, pp. 288–303).

Sobkowicz, P., Kaschesky, M., & Bouchard, G. (2012). Opinion mining in social media: Modeling, simulating, and forecasting political opinions in the web. *Government Information Quarterly*, *29*(4), 470–479. doi:10.1016/j.giq.2012.06.005

Sterman, J. D. (2002). System dynamics: systems thinking and modeling for a complex world.*Proceedings of the ESD Internal Symposium*.

System Dynamics Society. (2014). The field of System Dynamics. Retrieved from http://www.systemdynamics.org/what_is_system_dynamics.html

Toriumi, F., & Ishii, K. (2010). Simulation of encouragement methods for sns based on user behavior model. *Proceedings of 3rd World Congress on Social Simulation*.

Toriumi, F., Yamamoto, H., & Okada, I. (2012). Why Do People Use Social Media? Agent-Based Simulation and Population Dynamics Analysis of the Evolution of Cooperation in Social Media. *Proceedings of the 2012 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology (WI-IAT)* (Vol. 2, pp. 43–50). doi:10.1109/WI-IAT.2012.191

Toriumi, F., Yamamoto, H., & Okada, I. (2013). Effects of Controllable Facilitators on Social Media: Simulation Analysis Using Generalized Metanorms Games. *Proceedings of the 2013 IEEE/WIC/ACM International Joint Conferences on Web Intelligence (WI) and Intelligent Agent Technologies (IAT)* (Vol. 3, pp. 114–117).

Wang, B., & Moon, Y. B. (2013). Hybrid modeling and simulation for innovation deployment strategies. *Industrial Management & Data Systems*, *113*(1), 136–154. doi:10.1108/02635571311289719

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