GLOBAL DYNAMICS OF INNOVATION IN SOCIAL NETWORKING

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ABSTRACT
The purpose of this paper is to present a three dimensional model of innovation process applicable for analysis of global dynamics of innovation in social networking. It refers to known models of technological innovation based on two dimensions: (1) Performance evolution in time, usually exponential in nature, e.g. Moore's law for microelectronic chips and (2) Innovation diffusion with rate expressed by number of adopters vs. time e.g. due to imitation of early adopters or due to public access to innovation sources. On basis of literature review and available empirical data, a new third dimension called (3) Interactivity level is proposed and defined in this paper. It is specific to innovations in social networking. The interactivity level reflects amount of active knowledge and effective use of social media/technologies. This dimension has not been systematically studied yet. However some recent surveys of social media users demonstrate a need and suggest feasibility of assessment of this dimension. By introducing a scale of interactivity level, expressed by mode and intensity of interactive contacts among users of different social media, it is possible to improve evaluation of dynamics of innovation in social networking. Comparative study of average interactivity levels of users in different countries is proposed as an indicator of evolution of social media in the global business environment. Theoretical basis for such measurement is derived from communication studies on interactivity viewed as a sociological phenomenon.

INTRODUCTION

Social networking in combination with a number of tools and means facilitating broad interactive communication became one of important innovations affecting business operations in the 21st century. All elements of this broad innovation constitute an implementation of the Web 2.0 platform for exchange of information and opinions as well as for active collaboration among multiple actors involved in basic business processes. Social networking may be viewed as a process of using different social media for achieving certain goals through interactive communication and collaboration.

According to Kaplan and Haenlein (2010) "the *social media* is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content." Web 2.0 sites allow users to interact and collaborate with each other in a dialogue as creators of user-generated content in a virtual community, in contrast to websites of Web 1.0 where users are limited to the passive viewing of content that was created for them. The same authors proposed a classification of social media in which they distinguished six types of media. Three of them provide a high level of self-presentation. These are: *blogs, social networking sites* (e.g. Facebook, MySpace,Twitter, Orkut, LinkedIn, QQ, Qzone etc), and *virtual social worlds* (e.g. Second Life). Other three: collaborative projects (e.g. Wikipedia), content communities (e.g. YouTube), and virtual game worlds (e.g. World of Warcraft) provide low level of self-presentation. Certain level of confusion arises in literature due to multiplicity of terms being used by different authors. In addition to those

mentioned above some authors use the term *social technologies* as equivalent of social media seen as software technologies enabling operation of the media (Bughin, 2012), (Bughin,Hung Byers, Chui, 2011), (Brown, Sikes, 2012). Others include in their analyses such media as RSS (Rich Site Summaries) and podcasts (Li, Bernoff, 2011). More general term of *social networks*, which is sometimes used in this context, refers to certain type of sociological phenomenon that in current reality is supported by the social media. This concept is subject of both economic and sociological analyses (Benkler, 2006), (Carlsson, 2004), (Rainie, Wellman, 2012). According to the latter, social networks are facilitated by technological systems: "The internet and mobile phones have facilitated the reshaping of people's social networks, enabling them to be larger and more diverse. And they have reconfigured the way people use their networks to learn, solve problems, make decisions, and provide support to each other." (Rainie, Wellman, 2012). Impact of new media on current and future business practices has been emphasized by De Kare-Silver, M. (2011) and strongly supported by Barry Libert in his interview with Knowledge@Wharton (2012). Broader social impact of digital technologies (including social media) in relationship with demographic structure of society has been presented by Tapscott (2009), and multiple perspectives on global networking for innovation supported by those technologies have been described by Pelc (2012).

The subject of this paper is innovation in social networking. That innovation takes place by implementation of a broad range of social media and social technologies. The purpose of the paper is to introduce an additional dimension of innovation dynamics that is suggested for analysis of innovation adoption in social networking. That dimension is called "interactivity level." It is intended to explore innovation adoption process not only through number of adopters but also by assessment of their mode/depth of adoption demonstrated by the range and frequency of usage of elements of the adopted social media/technologies. Empirical data and illustrations concerning innovation adoption have been extracted, derived or compiled from survey results published by Forrester Research, McKinsey Global Institute, and Socialbakers.

Importance of social networking for business has been recently explored and discussed in several publications. Brown and Sikes (2012) indicated that social networking is one of the most effective means of digital business. Their survey data suggest that 28% of executives emphasized benefits for their companies due to this new approach. More particular measurable benefits from using the Web 2.0 media/technologies for increasing the speed of access to knowledge and for reducing communication costs have been confirmed by more than 60% of respondents in a McKinsey survey of companies (Bughin and Chui, 2010). According to another McKinsey study the most effective social media in support of business processes are blogs, social networking sites and video-sharing when used for scanning of external environment, finding new ideas, and for managing projects (Bughin, 2012). Those data and opinions suggest that an insight into detailed mechanisms of adoption of those innovative tools for social networking is needed.

In the following section a review is presented of conventional dimensions of innovation dynamics. Then a definition of interactivity level, as a new dimension of innovation dynamics, is proposed together with suggested way of its application for assessment of innovation dynamics in social networking. The next section of the paper is focused on diffusion of social networking innovation in the global business environment. It presents international comparative data on diffusion and interactivity. In the final remarks we propose some directions of further research.

CONVENTIONAL DIMENSIONS OF INNOVATION DYNAMICS

Analysis of innovation dynamics has been based on two main dimensions: (1) *Functional performance* of a technology (i.e. products, processes, systems) and its changes in time due to innovations, and (2) *Diffusion rate* typically expressed by number of innovation adopters in time.

The first dimension, functional performance, may be either based on a selected parameter representing the main functional feature of technology (e.g. fuel efficiency of an engine, max. speed of aircraft, density of transistors on a chip) or an aggregate measure of performance defined as combination of specific attributes of technology (e.g. computing power of a computer is combining such parameters as processing speed, RAM capacity, HD capacity and other specifications of the device into one aggregate measure of performance). Improvements of performance resulting from innovations may be incremental or radical (breakthrough). Typically the evolution of technology within a single technological generation follows S-curve shape of performance vs time that is best approximated by logistic function (Girifalco, 1991). Long term evolution of performance (through many generations of technology) is frequently exponential. One example of such exponential growth is expressed in the form of "Moore's Law" for microelectronic devices, which says that the feature density of a chip is doubling approximately every 18 - 24 months, or the number of transistors on every processor chip is doubling approx. every 18 - 24 months. It means the functional capacity of processor is growing exponentially. It is presented in Fig. 1, where linear form of the graph is due to logarithmic scale of microprocessor chip performance (transistor count). This empirical rule has been based on observations made by Gordon Moore, co-founder of Intel Corporation. Growth of performance following that rule has been observed during the last 40 years. Recent studies indicate a possibility that the rate of growth may slow down in the second half of current decade to the doubling period of 2.5 – 3 years.

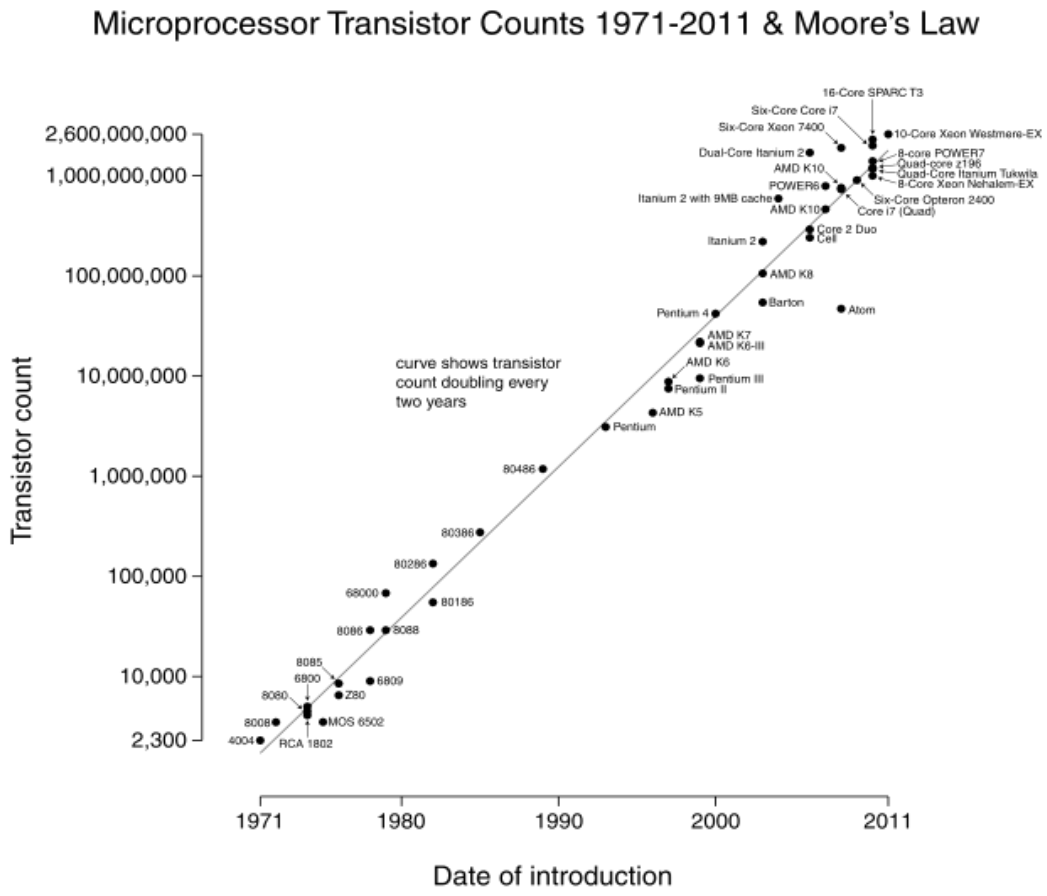

Fig. 1. Exponential growth of functional performance illustrated by Moore's Law. Graph extracted from article on "Moore's Law"(anonymous) in Wikipedia (retrieved 11/28/2012).

The second dimension, diffusion rate, expressed by number of adopters as function of time, is an indicator of adoption of innovation by population of users. It may advance at a different speed depending on access to information about the innovation and learning capabilities of actors involved in the adoption process. Several models of that process are presented in literature (Rogers, 2003). Based on literature review, at least three groups of models can distinguished. One of them, illustrated by the *Coleman model*, assumes that the source of innovation, and information about it, is open and public, making access to it equally probable for all potential adopters (Skiadas, 1985). In this case diffusion rate is very fast in the early period (initiation) and slows down with time (saturation). Second, clearly defined type, e.g. *Dodd model*, is based on assumption that adoption is driven by imitation process, in which adopters are learning from the earlier adopters and growth of adopters' population is epidemic in its nature (Sharif, Ramanathan, 1981). In this, most common case, number of adopters is growing in time according to logistic function. Some authors distinguish such groups of adopters as "innovators", "early adopters," "early majority," "late majority", and "laggards." (Rainie, Wellman, 2012) depending on their timing in the diffusion process. Third type of models, e.g. *Mahajan- Schoeman model* (Mahajan, Schoeman, 1977) combines both mechanisms of diffusion of previous two models i.e. certain adopters decide on basis of publicly accessed information when others follow the imitation route. Depending on proportion between two groups of adopters the rate of diffusion may fluctuate between the two earlier functions of time. In each model a saturation phase takes place (slow growth) when a large majority of population adopted the innovation.

In case of diffusion of innovation in social networking it is important to consider possibility of different "depth of adoption" by individual adopters. That "depth" is gradually changing during the learning process. As the main functional purpose of social media/technologies is to enable interactive communication involving the user created content (according to Web 2.0 philosophy) the extent of interactivity among adopters is changing with time. Adoption is not just an event, it is a learning process. Users operate in different modes depending on phase of learning. It means, there is a need to introduce an additional dimension for analysis of dynamics of this kind of innovations.

INTERACTIVITY LEVEL: A NEW DIMENSION OF INNOVATION DYNAMICS

According to Kiousis (2002) *interactivity* can be defined as "the degree to which a communication technology can create a mediated environment in which participants can communicate (one-to-one, one-to-many, and many-to-many), both synchronously and asynchronously, and participate in reciprocal message exchanges (third-order dependency)."

In case of social networking, a measure of interactivity level has to reflect operational capability and effective application of either individual or combined social media for communication in the modes of one-to-many and many-to-many. Innovation dynamics in this domain may be then characterized by frequency and complexity of those applications. For that purpose we propose the following definition: *interactivity level* (in social networking) is a number, e.g. on scale of one to six, reflecting complexity and intensity of interactive operation mode of actors involved in social networking. The higher is the number, the more complex operation mode and/or more frequent use of respective social media.

Li and Bernoff (2008 and 2011) distinguished interactivity levels of different actors involved in social networking by grouping them into clusters called: creators, critics, collectors, joiners, spectators and inactives. Those groups are identified by surveys in different communities and constitute a profile of "social technographics" for each of those communities. These authors presented a very useful empirical material, based on Forrester Research surveys, which illustrates practical application of the concept of interactivity level.

Table I. Interactivity levels, interactivity modes/phases, and corresponding interactivity tasks by actor groups in surveys conducted by the Forrester Research

*) Note: List of tasks and actor groups presented in column 3 has been adopted from the book:
Li, C. and Bernoff, J. *Groundswell* , Harvard Business Press (2008)

INTER ACTIVITY LEVEL	INTERACTIVITY MODE AND INNOVATION ADOPTION PHASE	INTERACTIVITY TASKS AND ACTOR GROUPS*) (ACCORDING TO FORRESTER RESEARCH SURVEYS)
6	Design and implementation - Interactive networking and communication with other users of social media - Creating own contents and publishing in a broad range of social media	Webpage design and publication Blog design and publication Photo creation and publication Video creation and publication Music creation and publication Texts creation and posting Group in the Forrester Research surveys: "Creators"
5	Evaluation - Experimenting with interactive communication through selected media - Contributing to contents created by other users	Comments on blogs of other authors Comments in online forums Rating of products/services Editing of wiki texts Group in the Forrester Research surveys: "Critics"
4	Selection and classification - Limited use of social media for communication - Classifying different forms of social media	Tags application for classification of Webpages, photos etc Online voting for Websites Using RSS feeds Group in the Forrester Research surveys: "Collectors"
3	Focused observation - Observation of social networking sites and testing own capability to use them - Learning how to use social networking effectively	Visiting social networking sites Maintaining profile on a social networking site Group in the Forrester Research surveys: "Joiners"
2	Field exploration - Random observations of different user created contents - Getting acquainted with some features and communication potential of social media	Reading social media presentations e.g. blogs, online forums, customer reviews and ratings Listening to podcasts Watching videos (YouTube) Group in the Forrester Research surveys: "Spectators"
1	Initial learning - Learning about existence of social media	Not performing any tasks Group in the Forrester Research surveys: "Inactives"

Correspondence between interactivity levels and operational modes in subsequent innovation adoption phases on one part, and tasks analyzed in the studies presented by Li and Bernoff on the other, is shown in Table I. The following innovation adoption phases (levels of interactivity) are included: initial learning, field exploration, focused observation, selection and classification, evaluation, design and implementation. They are reflecting the learning process of interactive communication in social networking. Adopters practice interactivity by gradually moving from Level 1 of initial learning about existence of social media to Level 6 of design and implementation of interactivity by the user created contents of messages.

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Diffusion of innovation is dependent on many factors: economic, social, technological, cultural etc. In case of social networking that process has been relatively fast in both the adoption rate by general population and the adoption rate by businesses, customers, suppliers etc. In this section we focus on diffusion in different countries as characterized by the overall rate of adoption of social media and by changes in the level of interactivity in social networking. The adoption of social network sites by general population is illustrated by statistics on use of the Facebook based on data published by Socialbakers (2012). This company is using the term of "penetration" as equivalent of adoption rate i.e. percentage of population using the social networking site in a given point of time. In Tables II, III, and IV penetration by Facebook in late months of 2012 is shown for three groups of countries.

Table II presents top ten countries in terms of the level of Facebook penetration (% of total population of the country). It is interesting to note that the leader of this "elite group" is Monaco with penetration rate over 100%, meaning that there are several people owning more than one Facebook account. Only two other European nations qualified into the global top ten: Gibraltar and Iceland with over 70% penetration. There is no single country of North America among them. Majority in this group is constituted by countries of small total population, mostly islands or small Arab countries such as Qatar and United Arab Emirates.

Table III presents bottom ten countries ordered by the lowest % of Facebook penetration. China is shown at the very bottom (with 0.04% penetration only). It is due to the fact that Facebook has not been established as a stable social networking site in that country where majority of users are served by Chinese social networking sites such as QQ and Qzone. All other countries on the list of lowest penetration are located in Africa or Asia with penetration levels ranging from 0.4% to 1.4%.

Table IV presents Facebook penetration rates of selected developed countries including the U. S. , U. K., and Germany (of the Western hemisphere), and Japan, South Korea and Hong Kong (of the Eastern). It may be seen that the highest Facebook penetration in this group is 59.1% in Hong Kong, when in the U.S. and U.K. it's almost the same of about 54%. In terms of absolute number of Facebook users, the U. S. is still at the global top with almost 169 million users.

All those data extracted from the Socialbakers website http://www.socialbakers.com/facebook-statistics/ present just one point on the time scale (end of 2012). To analyze dynamics of innovation diffusion, one would have to build a time series of data for certain period of time. The Socialbakers offer such possibility, not only for Facebook but also for Twitter, YouTube, Google+, and LinkedIn, considered to be the top five social media in terms of scale of their penetration.

Table II. Highest Facebook penetration in population of countries

% of population using Facebook in respective countries in 2012. Data derived from: Socialbakers "Facebook Statistics by Country," http://www.socialbakers.com/ , retrieved 11/28/2012.

RANK ORDER (Top 10)	COUNTRY/CONTINENT	FACEBOOK PENETRATION RATE % OF POPULATION (2012)
1.	Monaco/Europe	108.72*)
2.	Qatar/Western Asia	82.72
3.	Falkland Islands /South America	82.64
4.	Iceland/ Europe	76.35
5.	Aruba/South America	74.50
6.	Gibraltar/Europe	73.30
7.	Turks & Caicos Islands /Central America	71.61
8.	United Arab Emirates /Southwest Asia	67.27
9.	Brunei/Southeast Asia	65.93
10.	Singapore/Southeast Asia	62.44

*) Penetration rate above 100% suggests that some users own more than one Facebook account.

Table III. Lowest Facebook penetration in population of countries

% of population using Facebook in respective countries in 2012. Data derived from: Socialbakers "Facebook Statistics by Country," http://www.socialbakers.com/ , retrieved 11/28/2012.

From the lowest end (Bottom 10)	COUNTRY/CONTINENT	FACEBOOK PENETRATION RATE % OF POPULATION (2012)
1.	China/Asia	0.04*)
2.	Niger/Africa	0.40
3.	Tajikistan/Asia	0.55
4.	Uzbekistan/Asia	0.56
5.	Guinea/Africa	0.58

6.	Burkina Faso/Africa	0.82
7.	Afghanistan/Asia	1.22
8.	Madagascar/Africa	1.29
9.	Malawi/Africa	1.29
10.	Mali/Africa	1.38

*) China's lowest penetration of Facebook is probably due to popularity of other social networking media e.g. QQ or Qzone, and practical absence of Facebook due to intermittent blocking in that country.

Table IV. Facebook penetration in population of selected developed countries

% of population using Facebook in respective countries in 2012. Data derived from: Socialbakers "Facebook Statistics by Country," http://www.socialbakers.com/ , retrieved 11/28/2012.

COUNTRY/ CONTINENT	**FACEBOOK PENETRATION RATE % OF POPULATION (2012)**
U. S. /North America	54.36
U. K. /Europe	54.19
Germany/Europe	30.78
Japan/Asia	12.81
S. Korea/Asia	19.59
Hong Kong/Asia	59.12

As mentioned in the previous section of the paper, we suggest applying interactivity level as an important dimension of innovation dynamics in social networking. In Table V data have been compared for interactivity levels in selected six developed countries between 2007 and 2010 (or 2009 for some countries). They indicate changes in levels of interactivity in each country reflecting dynamics of adoption process among on-line customers participating in the surveys conducted by Forrester Research (reported by Li, C. and Bernoff, J. in two subsequent editions of their book). Those changes illustrate phases of innovation adoption process according to the concept presented in the earlier part of this paper.

From data of Table V, it is possible to recognize that the most dynamic changes of interactivity levels (adoption of innovation) took place in South Korea where percentage of on-line consumers actively involved in social networking increased most visibly at each level of interactivity higher than Level 1. For instance percentage of users communicating interactively at Level 6 jumped from 38% to 68% between 2007 and 2009. It means that 68% of on-line consumers performed fully interactive communication using broad range of social media in 2009 (see Table I for

description). It is the highest percentage of interaction at that level achieved in all six countries under consideration. At the same time, percentage of Level 1 interactivity (Initial learning) decreased in that country from 36% in 2007 to 7% in 2009. It means that only 7% of on-line consumers involved in social networking still remained at the lowest level of interactivity in 2009.

For comparison, data of the same Table V indicate that the least dynamic changes of interactivity level took place in Germany where percentage of on-line consumers actively involved in social networking at several levels of interactivity has changed very little. For instance percentage of users communicating interactively at Level 6 remain the same 8% between 2007 and 2010. At the same time, percentage of on-line consumers operating at the lowest Level 1 (initial learning) remained almost unchanged (decline from 49% to 48%). Both of these data indicate a very low dynamics of adoption of interactivity in social networking by on-line consumers in that country.

Table V. Changes of interactivity levels of social media users in selected countries between 2007 and 2010 (or 2009)

Average % of on-line consumers involved in interactive social networking at different interactivity levels. Data compiled from: Forrester Research surveys presented by Li and Bernoff, (2008) and (2011).

	U. S.		U. K.		Germany		Japan		S. Korea		Hong Kong	
INTER ACTIVITY LEVEL	**2007 %**	**2010 %**	**2007 %**	**2010 %**	**2007 %**	**2010 %**	**2007 %**	**2009 %**	**2007 %**	**2009 %**	**2007 %**	**2009 %**
6	18	23	9	16	8	8	22	36	38	68	34	36
5	25	33	16	26	22	13	36	42	27	66	46	37
4	12	19	5	9	12	4	6	18	14	37	17	38
3	25	59	21	50	12	27	22	29	41	58	26	50
2	48	68	37	55	44	42	70	75	39	84	67	79
1	44	19	54	29	49	48	26	17	36	7	27	16

FINAL REMARKS

Results of study reported in this paper support two initial concepts. The first of them, concerns the possibility of applying conventional models of innovation diffusion to analysis of social networking as an important innovation in contemporary business practice. The second, more original concept, concerns the need of new dimension in that analysis i.e. interactivity level. In case of social networking that dimension reflects the very nature of innovation. Introducing of that dimension is based on observation that the decision on innovation adoption for social networking is not a single event. To the contrary, it is a process, during which the adopter is learning experientially how to communicate interactively through social media. The proposed dimension of interactivity level should be explored further by collecting data and time series in a

longer period of observations. Distinction of just six levels of interactivity within the adoption process of social networking may also require verification. The global aspect of social networking implementation could a subject of further research oriented to enlarged set of countries and their cultural, economic, social and technological capabilities. That research could reveal new ways of diffusion of social networking in global business environment and suggest new methods for accelerating learning processes. The central goal of research would be to explore prospects for interactive communication through social networking among global partners, customers, suppliers, researchers and all other stakeholders in support of efficiency in all functional areas of business.

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