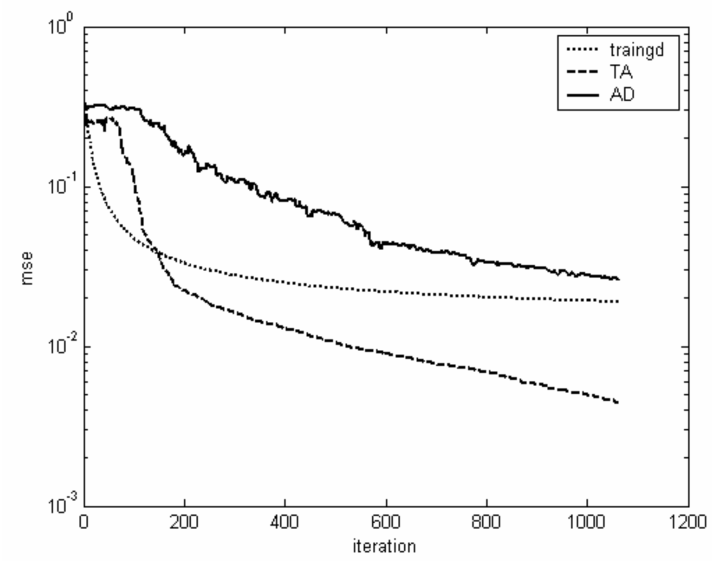

Fig. 1. Comparison of best result obtained by BP, AD and TA

References: 1. *Haykin S.* Neural networks: a comprehensive foundations.-McMillan.-1994. **2.** *Shang Yi, Wah Benjamin W.* Global optimization for neural network training. - Coordinated science laboratory, University of Illinois at Urbana-Champaign, June 24, 1996. **3.** *Duch W., Korczak J.*, Optimization and global minimization methods suitable for neural networks, department of computer methods, Nicholas Copernicus University, Poland, Laboratoire des sciences de l`Image, de l`Informatique et de la Télédétection, CNRS, Université Louis Pasteur, France, 1998. **4.** *Nguyen D., Widrow B.*, Improving the learning speed of 2-layer neural networks by choosing initial values of the adaptive weights. Proceedings of the International Joint Conference on Neural Networks, 1990.-№3.-:21-26. **5.** *Whitley D., Kauth J.* GENITOR: A different genetic algorithm, Proc. Rocky Mtn. Conf. on AI, 118-130, 1988. **6.** *Kirkpatrick S., Gelatt C., Vecchi M.*, Optimization by simulated annealing, Science, vol. 220, pp. 671-680, 1983. **7.** *Creutz M.*, Microcanonical Monte Carlo simulation, Physical Review Letters, vol. 50, no 19, pp. 1411-1414, 1983. **8.** *Wood I A., Downs T.*, Demon algorithms and their application to optimization problems. In Proceedings International Joint Conference on Neural Networks 2, Anchorage, Alaska, USA, pp. 1661-1666, 1998. **9.** *Dueck G., Scheuer T.*, Threshold accepting: a general purpose optimization algorithm appearing superior to simulated annealing, Journal of Computational Physics, vol.90, pp. 161-175, 1990. **10** *White S.R.*, Concepts of scale in simulated annealing, Proc. IEEE ICCD, Port Chester, NY, 646-651, 1984. **11.** *Aarts E. H. L., van Laarhoven P. J. M.*, A new polynomial-time cooling schedule, Proc IEEE ICCAD-85, Santa Clara, CA, 206-208, 1985. **12.** *Otten R.H.J.M., van Ginneken L.P.P.P.*, Annealing applied to floorplan design in a layout compiler, Proc Automation `86, Houston, TX, 185-228, 1986. **13.** *Mangasarian O.L., Setiono R., Wolberg W.H.* Pattern recognition via linear programming: Theory and application to medical diagnosis.- Large Scale Numerical Optimization.- SIAM Publications.- p. 22-30, 1990

Поступила в редколлегию 19.02.08

UDC 681.518

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SPONTANEOUS DIFFUSION OF INFORMATION IN ONLINE SOCIAL NETWORKS

Онлайнові соціальні мережі (ОСМ) є новими типами веб-сервісів, які пропонують онлайновим суспільствам середовище для гуртування та віртуального спілкування. Як наслідок, такі віртуальні мережі соціальних зв‘язків мають високий потенціал для впливового прийняття рішень та розповсюдження інформації «з вуст в уста», але, з іншого боку, вони також можуть розповсюджувати чутки, плітки та некоректну інформацію. Потенціал цих мереж також розпізнається сервіс-провайдерами, маркетологами та виробниками товарів. Вони усі бажають використовувати ці існуючі комунікаційні канали для розповсюдження реклами продуктів безпосередньо користувачам. Але не усі такі спроби є успішними. Ця робота робить спробу пояснити, чому ОСМ є добрим середовищем для спонтанного розповсюдження інформації та які етапи повинні бути виконані для досягнення оптимального рівня розповсюдження для одного елемента інформації. Ми починаємо з розгляду моделі гіперциклів Гартнера, яка пояснює надмірний ентузіазм при впровадженні нових технологій. Далі ми вводимо концепцію «соціального забруднення» та інфекційного розповсюдження інформації. Базова ідея нашого підходу полягає в тому, що онлайнові індивідуали прихильні до колективної поведінки, якщо вони віртуальну поведінку та дії інших. Цей принцип «спрямованості на інших» може генерувати ланцюгову реакцію інфекційних імітацій які інколи можуть розповсюджуватись неконтрольовано через соціальні мережі, подібно до епідемії.

Online Social Networks (OSN) are new types of web services which provide online communities an environment to gather and meet virtually. The online users are connected to each other via links of trust and utilize the features of the OSN to interact and communicate in an easy socio-technical way. Hence these virtual networks of social relationships have a high potential for influential decision-making and the word of mouth spread of information, but also for spreading fads, rumors, and erroneous information. The power of these new forms of social networks is also recognized by service providers, marketers and vendors of consumer goods. They would all like to (mis)use these existing communication channels to spread product placements, advertising and promotions directly to the connected users. However, just like the old economy businesses, not all attempted marketing initiatives are successful. Most of them fail or do not reach the desired audience. This paper tries to explain why OSN are a good environment for spontaneous diffusion of information and what phases of development need to be accomplished to reach the optimal spreading rate for one piece information. Therefore, we start with a look at the “Hype Cycle” model of Gartner to explain over-enthusiasm for new technology adoptions. Next we introduce the concept of “social contagion” and the infections spread of information. After a short introduction of OSN, we try to illustrate the phases of a social online contagion development process which can lead to spontaneous and uncontrolled diffusion of information, messages or ideas. The core statement of our approach is that online individuals tend to behave collectively if they observe the virtual behaviors and actions of others. This principle of “other-directedness” can generate a chain reaction of infectious imitation which can sometimes spread uncontrolled through the interconnected social network like an epidemic. This helps to explain why some online information waves can grow extraordinarily high and others fall.

1. Introduction. Every year The Gartner Group, a technology analysis company, publishes the so-called "Hype Cycles" of specific upcoming technologies. This graphical representation illustrates trends of a new and upcoming technology very well. Even though it is not a mathematical model, the curve helps to understand the current status of a "hyped" technology and tries to explain the typical phases which are passed through. This kind of collective euphoria can be observed in several areas today. When we are looking at consumer blockbusters like Harry Potter, Red Bull or recently the Apple iPhone, there is a lot of buzz about things which are attracting a big audience and generating huge media coverage. On the Internet there are similar examples of big success stories about fast growing websites which became dominant because of a positive diffusion of information about the service and their benefits at a the grassroots level. This kind of virtual "word of mouth" effect can leverage an online service or a web idea by infecting more and more online users and boosting the growth of the service itself.

For the old economy there are several models which describe how a new product, technology or concept gets successfully introduced, and how it gets adopted in the markets (e.g. [26]). The information about a new product or technology can be seen as a topic of interest (TOI) which has to pass through several diffusion phases until it gets a successful investment or flops. Consequently, it is very important to use an appropriate rollout strategy for the TOI to find the maximum adoption rate on the target side. In the area of the Internet, additional questions are arising, especially why and how some information can spread and diffuse surprisingly fast and lead to online phenomena which have not been seen before and others simply fail.

This paper is structured as follows: In chapter 2 we introduce the "Hyper Cycle" (HC) model from Gartner and use it as a starting point for the discussion on why ideas or technologies can spread successfully. Based on the limitations of the HC model, we introduce the theory of "social contagion" [9] as a concept of how people get mind-infected about some idea or even a collective action in chapter 3. In chapter 4 we give a short overview of Online Social Networks (OSN) and their applications. This knowledge helps us to investigate the underlying principle of spontaneous spread and diffusion of information through an OSN in chapter 5. This chapter focuses on the development phases and the given reasons of such fostering environments as seen in OSN. Finally this article closes with some considerations about the transformation of the online users due to the emerging mass phenomena of the Internet.

2. The "Hyper Cycle" model from Gartner. A well-known model about the maturity, adoption, and business application of specific technologies was intro-

duced by technology analyst Gartner [14] and was entitled – "nomen est omen" – as "Hype Cycle" (HC). Since 1995 the concept of Hype Cycles has been used by Gartner [14] to demonstrate the over-enthusiasm or "hype" and the subsequent decline following an introduction of new technologies. An HC is a graphical representation of the maturity, adoption, and business application of specific technologies. The HC also tries, on a qualitative level, to show how and when technologies move beyond their hype. Mainly the graph is trying to forecast when a topic of interest (TOI), e.g., Quantum Computing, will offer practical benefits for the users and become widely accepted. Certainly not all TOI run through such an HC and some even fail at the beginning of the HC.

Assuming we are looking at a potential high-flyer TOI like Web 2.0 [24], the typical HC passes the following phases [14] (see Fig. 1):

1. *Technology Trigger:* The first phase of an HC represents a breakthrough, a product launch, or another event (TOI) that generates significant interest in the target group.
2. *Peak of Inflated Expectations:* In this phase the publicity typically generates over-enthusiasm which leads to unexpected developments and growth rates.
3. *Trough of Disillusionment:* During this phase the overreaction normally cools down to more realistic expectations and a more critical view of the TOI can be observed. Consequently, the media and the target audience lose interest in the topic or technology and a downswing ensues.
4. *Slope of Enlightenment:* If the TOI is somehow fundamentally useful or profitable, it will overcome the "trough of disillusionment." Thus an understanding of the benefits and practical application of the technology is coming into being in this phase.
5. *Plateau of Productivity:* Finally, if a TOI has achieved this phase, the technology becomes widely demonstrated and accepted; it also becomes increasingly stable and evolves improved versions. The height of the final slope depends on how applicable or beneficial the TOI is.

One of the most influential HC according to Gartner [14] was the E-Business-Hype Cycle in 1999 that predicted the burst of the Internet bubble in spring 2000. But there have also been several failures in the HC prognoses of Gartner. In one of the first HC of 1995, for example, Gartner stated that "Wireless Communications" is at the upward trend and the "Information Superhighway" is losing importance, but it did not behave as predicted [13]. Many other HC are presented by Gartner over the years, and they had noticeable impact on decision makers and the market itself.

Although the Hype Cycle (HC) is a widely accepted analysis tool to graphically express the status of a technology or a product (TOI), it does not readily explain why a trend is emerging or how it can be initiated. Consequently, the HC is more a qualitative outlook which may include some estimations about the technological innovation and its future potential. The important starting phase of an HC (represented with the dotted box in Fig. 1) is not explained, and moreover, the underlying mechanisms of how and why the information about the TOI is spread are missing. But the diffusion of the information about the TOI is fundamental so that people get to know about it and adopt it over time [7] or even generate hype about it.

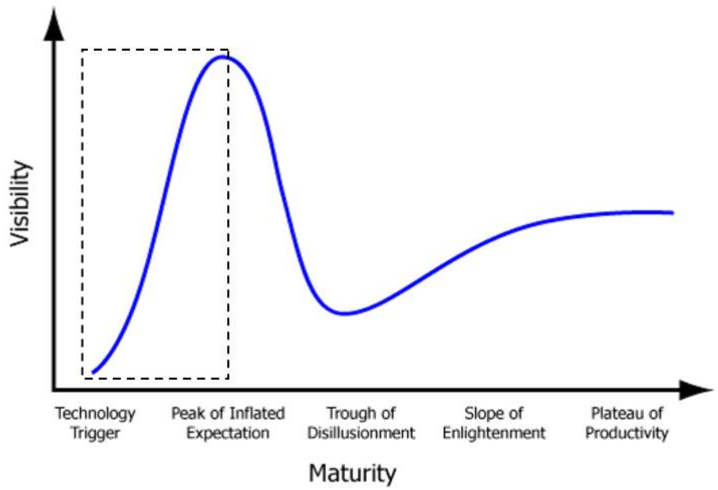

Fig. 1: Gartner's Hype Cycle [14]

3. Social contagion and diffusion of information. One way out of this weakness of the HC model is the utilization of the social psychological concept referred to "social contagion" [9]. The theory states that in a collective process the spread of ideas, attitudes, or behavioral patterns is emerging through imitation and conformity of the affected individuals ([16], [27], [22], [29]). The results of such mass phenomena are masses that end up in trends, fads, as well as hypes and panics. Like a snowball effect, it sometimes even leads to extraordinary results in a spontaneous, rapid and unpredictable way ([4], [20], [21]). The outcome of such a social contagion process can have positive or negative effects on the involved users and the environment.

In Fig.2 the main phases of a social contagion process are presented. Although all social mass phenomena vary, there are three main patterns which a fully developed crowd can go through [28]:

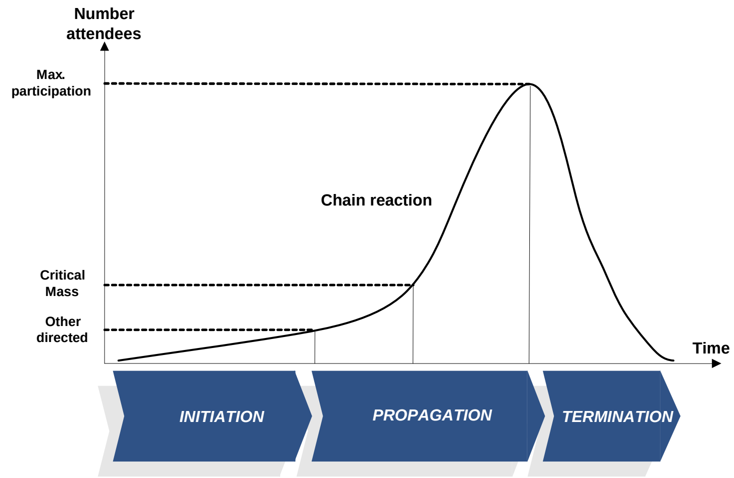

Fig. 2: Social contagion phase model [28] p.67

- *Stage 1 – Initiation:* The initiation of a social contagion process is normally triggered by some psychological attractors or a disruption of the observed environment. Typically these events wake up the concerned individuals and lift them to a higher level of increased attention. If the awareness of the audience becomes keener and additional psychological catalysts such as the classical and new media, trend-setters, opinion leaders and others come across, then the process tends to progress to the next phase.
- *Stage 2 – Propagation:* After the attainment of the "other-directed" threshold, the attendees tend to transform it from a self-aware and self-controlled state to an externally controlled state. From this point on more and more individuals tend to orient toward the behavior of others in the emerging crowd rather than rely upon their own expertise and decisions. If the "other-directedness" is starting to dominate a number of individuals, the contagion process has started effectively. At this time there is still a chance of slowing down the social contagion process. But if the number of individuals involved breaks through the most important threshold, the critical mass of other-directed attendees ([29], [8], [16]), the whole process switches into a radical chain reaction of collective mass behavior. Now the crowd is fully formed and the complex self-enforcing social interplay of the infected individuals is driven by "positive feedback loops" and "path dependence" [1] which can lead to unexpected and uncontrollable results. In

this stage the increase in newly activated users can reach exponential growth rates which can be seen in today's sales success stories like those of Harry Potter, iPhone, RedBull, and many more.
- *Stage 3 – Termination:* Almost every crowd has its expiration date, and typical indicators for the end of such an overreaction are the absence of new headlines, the appearance of critiques of the phenomena, first saturation effects, or simply the factor of time. If the psychological energy is diminishing, the euphoria normally breaks off radically and switches into a kind of panic or resignation. There are well-known and documented examples of this "irrational exuberance" [30]. The inevitable ending is arising as in the examples of financial crashes or Ponzi scheme oriented games [20].

Bikhchandani, Hirshleifer, and Welch [3] call these phenomena "information cascades." In these cases the overall process tends towards a direction where every subsequent user makes the same decision, based on the observations of others, independent of the private signal, which can lead to patterns of collective or sometimes irrational behavior [30].

4. Online Social Networks. Online Social Networks (OSN) like MySpace.com, Facebook.com, Bebo.com, or the video sharing platform YouTube.com, to name just a few, are promising areas to explore spontaneous diffusion of information. These Websites are very user-centric and massively dependent on how efficiently information can spread to existing and potential users. The principle idea of OSN is to build and maintain communities of personal social networks which have similar interests and activities or which are interested in exploring the interests and activities of others [5].

Therefore, these online platforms offer various ways to communicate and interact with each other for the individual members of such an OSN system. One of the major principles of OSN is the "visibility" of the other participants who flock together in this online community. Hence there are virtual profiles of the users as well as the possibility to connect with each other in a network of linked trusts. These virtual social networks enable the individuals to propagate and distribute information very easily through the electronic channels and to reach a broad audience with the same content and ideas. Additionally, most of the content and information about the online individuals are public and free to access for everyone on the Web. Thus it is quite easy to search the existing content and information of these OSN to connect virtually with the related persons.

The main target group of the OSN sites are teens and the young at heart, but there are also OSN for adults which are mainly called Online Business Networks (OBN) like LinkedIn.com or Xing.com. Their target is to interconnect business people to foster networking and professional objectives like job offers, cooperation, and sales leads.

As of November 2006 it is said [6] that the 10 most popular domains accounted about 40% of all page views on the Internet and nearly half of the views can be credited to the OSN systems MySpace.com and Facebook.com. Some of the registered users certainly are duplicates in different OSN and not all of them are active all the time. Anyhow, these online networked users are offering a high potential for the diffusion of information and the spread of rumors, fads, and trends.

5. Understanding spontaneous spread of information in OSN. On today's Internet the rules and the business models are continuously changing. More and more the classical marketing and advertising concepts are failing and drifting to more user-oriented and customer-driven approaches. One of the most important objectives is to spread information and attractors efficiently and rapidly to potential online users, so that they, for example, visit a website or behave in a profitable way. Therefore, the question is how online environments which support the diffusion of information or TOI can be established and fostered.

We assume that humans are behaving quite similarly on the Internet as they are in the real world but with a new degree of emergence due to the missing time and space limitations of the Web [25]. What we can see today is a highly interactive, dynamic and accelerating online network of connected people who are using all these Web technologies to facilitate and manage their social lives. On the basis of the phase model called "Online Crowds" (OC) [28] and the analogy of the biological spread of diseases, we investigate the practicality of the approach to explain spontaneous diffusion of information (TOI) in Online Social networks (OSN). Therefore, we reuse the phases of the OC model and the concept of "social contagion" from chapter 3 and extend them with the patterns and particularities of the observed domain of OSN and the underlying technological concepts of social software [5]. In Fig. 3 the outbreak of an "information virus" through an OSN system is illustrated. Similar to the "social contagion" development phases of Fig.2, the process requires two[1] known phases but needs to be extended by adding one additional phase called "Amplification":

- *Initiation phase:* At the beginning there is a need for some initial exciter like sensational news, a trend-setter or a disruption of the social or virtual environment which push-starts the TOI into the attention of the first indi-

[1] The „Termination“ phase is not taken into account at this point because the paper mainly focuses on the acceleration effects of the first phases.

viduals. Normally, a minority group is communicating and exchanging the TOI among themselves and with new peers at this stage. According to Moscovici [23] a dominant and insistent minority group can change the opinion of the majority. This social behavior and the additional psychological attractors can help to increase the number of informed users. As more users get in contact with the TOI, they will transform from rational to other-directed behaviors as described in the previous chapter.

- *Propagation phase:* When the threshold of the "Rationality of Others" is reached, the users tend to imitate and repeat the information and signs observed by others more and more. Hence the TOI itself is changing from a kind of neutral information to a biased mind-virus for the receiver. To reach this threshold limit, the visibility and the information traces of other users are very important. Moreover, a rich feature set for self-expression, recommendation and sharing (spreader tools) is needed to push the TOI further. With the positive development of the process, social factors like awareness and reputation are getting more and more important. Hence rating systems, activity ranks, and interlinking of existing and new contacts are essential for advancement of a TOI.
- *Amplification phase:* If the increase of the number of infected users continues and additional users are getting in contact with the TOI, the spreading process may reach the most important threshold, the critical mass (see chapter 3). At this stage the tipping point [15] of the TOI, which determines whether it will die or it will get to an epidemic outbreak, is reached. The viral cascade is fully developed and everybody who gets to know about the TOI needs to adopt the information because of the euphoria and pressure from the others. To foster this stage and enlarge the number of potential target groups, an OSN can open its data and programming interfaces (API) to partners and multiplier technologies like Social Tagging, Weblogs, Mesh-ups, RSS-Syndication, and Back-Linking. Moreover, the infected users can be equipped with an "epidemic mission" to recruit and re-infect new users by a reward system which can be based on incentives such as money, or more intangible approaches like higher ranks, better status, or more features offered by the OSN. In analogy with Metcalfe's law that proclaims that the value of a telecommunications network is proportional to the square of the number of users of the system [11], the infection rate of a TOI grows non-linear with the number of new users. Moreover, the escalating effects of positive feedback loops and the nature of the Internet as a global, virtual, low-cost communication and collaboration network represents the strong foundation for such social "viral architectures" [18].

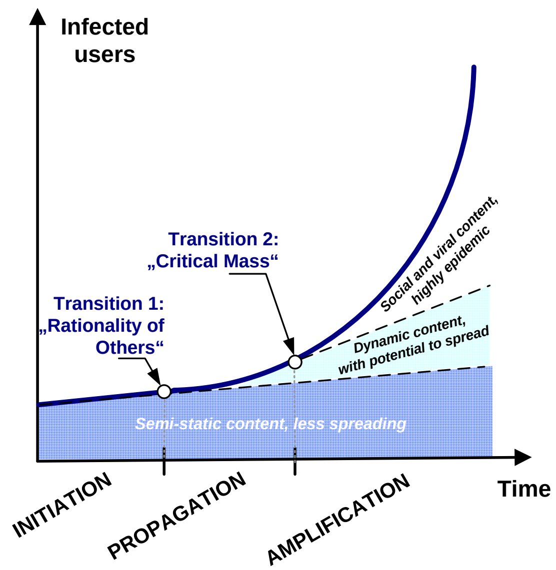

Fig. 3: Outbreak phases of a mind-based virus in OSN

Looking at the potential effectiveness of an epidemic outbreak, three different types of virtual carrier levels can be identified. In Fig. 3 the contributing elements are differentiated in the following areas:

- *Linear spreading carriers:* Since the beginning of the Internet, these carriers have offered a static, or in the later years semi-static, ability to spread a "mind-virus". These features prevent the building of larger sources of infection because of the limited interaction possibilities by the users (respectively information consumers). Characteristic examples are static and insular websites, information broadcasting with limited interaction such as one-way distribution lists, contact mail, guest books, and web-based forms.
- *Semi-dynamic spread carriers:* Over the years the Internet emerged and moved to a more dynamic and interactive Web of users (and prosumers respectively) with an increased potential of spreading. Examples are discussion forums, chat systems, file uploads, and website editing features, as well as some sharing tools and search mechanisms.
- *Social and viral spread carriers:* In the last few years, the features changed dramatically and combined social software concepts with the feasibility of user-generated content [19]. These carriers represent important portions of the exceptionally strong viral carriers for any type of TOI. Explicit exam-

ples are full-fledged online platforms with rich media content and easy-to-use but powerful authoring and editing tools as well as extensive cross-referencing and cross-linking mechanisms. At a first glance, these online features help to find, connect, and maintain the social ties and to transform the day-to-day social contacts and behaviors into the Web. On a deeper view, these kinds of spreading tools help to push an initially small and local TOI to a fully developed epidemic outbreak of parts of the OSN and beyond.

If these principles are applied correctly, there is a high potential to generate spontaneous spread of information (TOI) over the existing virtual social networks. The above-mentioned network effects rely on the basics of two well-studied theories:

- *Scale Free Networks (SFN):* In contrast to old theories with a random structure of social networks and the Internet, Barabási and Bonabeau [2] found out that the connections of these kinds of networks are "power law distributed." This has several implications on the properties of these networks. First of all the topology consists of very few nodes with lots of connections (so-called hubs) and a lot of nodes with only a few links. Second the SFN are robust against random threats but very fragile when only a few major hubs are infected. This could cause emergent information cascades and unusual social contagion waves.
- *Small World Networks (SWN):* According to Watts [31] each individual is connected, on average, to each other by six human nodes. So only a few people in a group are necessary to reach a lot of different individuals. The graph degree distributions are defined with the properties "clustering coefficient" and "mean-path length." Thus typical social relations follow a long tail distribution with some highly connected social hubs, and SWN can follow the characteristics of SFN. This could circumstantiate why social contagion and information viruses can happen in very spontaneous and unexpected ways.

Typical examples which comply with these network paradigms are the Internet itself, air transportation networks, electronic power grids, and social influential networks. Putting these approaches together helps to understand how the spreading of information and collective behavior are stimulated and accelerated. It has to be mentioned that not all presented socio-technical network effects are amplified 100% in OSN. There are always attrition rates and forces that countervail the leveraging effect [10]. Especially the factors of time and loss of additional psychological drivers are providing essential contributions if the "Termination or Substitution" phase of a social contagion is opened up.

6. Conclusion and future work. A lot of research has been done in the area of diffusion of information and the adoption of innovation in the last decades. A quite similar attempt of [17] is trying to analyze the diffusion of information in Weblogs and also on the concepts of threshold models and the spread of information although [17] focus more on the connection structure and stickiness of the Weblog network than on the socio-technical aspects of the phenomena. In this paper we have discussed reasons why OSN are very advantageous environments for mind-based outbreaks of epidemics of TOI. Apart from the leveraging network effects of the Internet and the social networks, there are psychological rules acting in the background which facilitate social contagion processes in the real world as well as on the Web. If an infectious TOI can reach the critical mass of users, an epidemic outbreak can happen instantly. In this case the infection rate can change from linear to exponential growth and tend to contaminate most of the users of an OSN.

From the Internet user point of view, there has been a shift in the last years from technical-user centric to a more mass-user and community centric approach on the Web. Especially the encouraging environment of high-speed but flat-rate Internet access, easy-to-use web interfaces, out-of-the-box features and tools, as well as a broad penetration of the Internet itself, bypasses the hurdles for an average user and supports the appearance of epidemic TOI outbreaks. In

Fig. 4 the user transformation from the so-called Web 1.0 to the current and often mentioned Web 2.0 [24] is illustrated with some selected examples.

Web 1.0		**Web 2.0 and OSN**
Self	→	*Social*
Consumer	→	*Prosumer / Imitator*
Rational	→	*Viral*
Push	→	*Pull*

Fig. 4: User behavior transformation from Web 1.0 to Web 2.0

What we can see today is that epidemic outbreaks of TOI and the social contagion developments are getting more intensive and are affecting more users than some years ago. Hence there is potential as well as challenges arising from these new phenomena on the Internet. As the economist Peter Drucker stated, "The mass movement has become the dominant political phenomenon of the century." ([12] p.94), there is the potential that the overall mass behavior of the Internet users will become the dominating virtual phenomenon of our century.

References: 1. *W. B. Arthur.* Increasing Returns and Path Dependence in the Economy. University of Michigan Press, 1994. **2.** *A. L. Barabási, E. Bonabeau.* Scale-free networks. Scientific American 288, pp.60-69, 2003. **3.** *S. Bikhchandani, D. Hirshleifer, I. Welch.* Learning from the Behavior of Others: Conformity, Fads, and Information Cascades. American Economic Association in Journal of Economic Perspectives, pp.151-170, 1998. **4.** *E. Bonabeau.* The Perils of the Imitation Age. Harvard Business Review Article, Jun 1, pp.45-47, 49-54, 2004. **5.** *D. Boyd, N. B. Ellison.* Social Network Sites: Definition, History, and Scholarship. Journal of Computer-Mediated Communication, Vol. 13, No. 1-2, 2007. **6.** *J. Breslin, S. Decker.* The Future of Social Networks on the Internet – The Need for Semantics. Digital Enterprise Research Institute, Galway, IEEE Internet Computing pp.87-90, 2007. **7.** *F. J. Carter Jr., T. Jambulingam, V. K. Gupta, N. Melone.* Technological innovations: A framework for communicating diffusion effects. Information & Management, 38(5), pp.277-287, 2001. **8.** *B. Celen, S. Kariv.* Observational learning under imperfect information. Games and Economic Behavior 47(1), pp.72-86, 2004. **9.** *A. Colman.* A Dictionary of Psychology. Originally published by Oxford University Press, 2001. **10.** *P. S. Dodds, R. Muhamad, D. J. Watts.* An Experimental Study of Search in Global Social Networks. Science, 8 August 2003, Vol. 301. no. 5634, pp.827-829, 2003. **11.** *L. Downes, C. Mui*. Unleashing the killer app: digital strategies for market dominance. Harvard Business School Press, 1998. **12.** *P. F. Drucker*. The New Realities. Transaction Publishers, Rev. Ed., 2003. **13.** *J. Fenn, A. Linden.* Gartner's Hype Cycle Special Report for 2005. 10th anniversary of Gartner's Hype Cycles, ID Number: G00130115, www.gartner.com/resources/130100/130115/gartners_ ype_c.pdf, 2005. **14.** *Gartner.* Understand Hype Cycle. Gartner Group, www.gartner.com/pages/story.php.id.8795.s.8.jsp, 2007. **15.** *M. Gladwell.* The Tipping Point: How Little Things Can Make a Big Difference. Little Brown, 2001. **16.** *M. Granovetter.* Threshold Models of Collective Behavior. The American Journal of Sociology, Vol. 83, No. 6, pp.1420-1443, 1978. **17.** *D. Gruhl, R. Guha, D. Liben-Nowell, A. Tomkins.* Information Diffusion Through Blogspace. In proceedings of the 13th International World Wide Web Conference (WWW'04), pp.491-501, 2004. **18.** *K.H. Lee.* Viral Architectures. MIT Media Lab, Viral Working Group, web.media.mit.edu/~kwan/ Projects/viralarchitectures.pdf, 2005. **19.** *E. Lesser, M. A. Fontaine, J. A. Slusher.* Knowledge and Communities. Elsevier LTD, Oxford, 2000. **20.** *C. P. Kindleberger.* Manias, Panics, and Crashes: A History of Financial Crises. Basic Books, New York, 1978. **21.** C. MacKay. Extraordinary Popular Delusions and the Madness of Crowds. With a foreword by Andrew Tobias, Harmony Books, New York, 1980. **22.** *D. Kempe, J. Kleinberg, E. Tardos.* Maximizing the Spread of Influence through a Social Network. SIGKDD '03, Washington, Proceedings of the ninth ACM SIGKDD international conference on Knowledge discovery and data mining, pp.137-146, 2003. **23.** *S. Moscovici, E. Lage, M. Naffrenchoux.* Influences of a consistent minority on the responses of a majority in a colour perception task. Sociometry, Vol. 32, pp.365-80, 1969. **24.** *T. O'Reilly.* What Is Web 2.0 – Design Patterns and Business Models for the Next Generation of Software. Oreillynet.com, www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html, 2005. **25.** *T. Postmes, S. Brunsting.* Collective action in the age of the Internet: mass communication and online mobilization. Social Science Computer Review, Volume 20, Issue 3, Special issue: Psychology and the Internet, pp.290-301, 2002. **26.** *E. Rogers.* Diffusion of Innovations. Fifth Edition. Free Press, New York, 2003. **27.** *M. Rolfe.* Social networks and threshold models of collective behavior. University of Chicago, Workingpaper, December 10, 2004. **28.** *C.Russ.* Online Crowds – Extraordinary mass behavior on the Internet. Proceedings of i-Media '07, Graz, Austria, pp.65-76, 2007. **29.** *T. C. Schelling.* Micromotives and Macrobehavior. Norton, W. W. & Company, Inc, 1978. **30.** *R. J. Shiller.* Irrational Exuberance. University Presses of CA, 2nd ed., 2005. **31.** *D. J. Watts.* The "New" Science of Networks. Annual Review of Sociology Vol. 30, pp.243-270, 2004.

Поступила в редколлегию 15.02.08

UDC 681.3.06

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TOWARDS QUALITY-AWARE PREDESIGN MODEL

У статті розглядаються основи пілходу до збирання семантики вимог якості у проміжну предпроектну модель. Цей підхід є поєднанням технологій Клагенфуртського концептуального предпроектування та аспектного предпроектування. Запропоновані додатки дозволяють включити до моделі ієрархію характеристик якості та подати наскрізні відношини між інтересами якості та основною функціональністю системи. Обговорені деякі напрямки інтеграції запропонованої моделі у процесс розробки програмного забезпечення, що керується якістю.

An approach to capturing the semantics of quality requirements into an intermediate predesign model is outlined. This approach combines Klagenfurt Conceptual Predesign and Aspectual Predesign techniques. Proposed extensions incorporate the hierarchy of quality characteristics into the predesign model and represent crosscutting relationships between the quality concerns and the main functionality of the system. Some directions of integration of the proposed model into quality-driven software process are discussed.

1. Introduction. One of the problems arising while developing an approach to incorporate quality-related issues into software process is a problem of finding an adequate representation of the semantics of quality requirements before performing design-time activities.

Following Klagenfurt Conceptual Predesign [12-13, 15] and Aspectual Predesign [19-20] approaches, to solve the above problem we propose to establish an intermediate semantic model (*predesign model*) residing between quality requirements elicitation and conceptual design. Such model has to describe the notion of the software quality that can be used on different stages of the software process, and capture the quality requirements semantics in a way that can be easily understood and verified by the system users. We call this model *Quality-Aware Predesign Model* (QAPM). In this paper we outline the main concepts of this model, more detailed description will be included in the follow-up papers.

The rest of the paper is organized as follows. Section 2 gives some important background information about software quality and existing predesign approaches. Section 3 describes the main features of the proposed predesign model. Section 4 is devoted to the integration of the described technique into broader context of quality-driven software process. Section 5 concludes the paper and shows the directions for future research.