

# User Innovation Networks and Research Challenges

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**Abstract.** User Innovation Networks (UIN) has been considered the open innovation model for this century as it functions entirely independently of manufacturers. This paper discusses two UIN cases, Daz3D, as well as Linux Dell and IBM cooperation as regards research challenges about the community of practice and interface used. It concludes that current technology only now started touching global and extreme collaboration for creativity and innovation.

**Keywords:** User Innovation Networks, Hybrid Synergy, Collaborative Creativity, Design, Social Network Analysis.

## 1 Introduction

Rapid technological changes influence communication, information, collaboration, and knowledge management. User Innovation Networks (UIN) has been considered the open innovation model for this century as it functions entirely independently of manufacturers. Networks can be built up horizontally with actors consisting only of innovation users (more precisely, “user/self-manufacturers” [1].) Free and open source software projects are examples of such networks. Some users have sufficient incentive to innovate and some other users to distribute voluntarily their innovations. If the innovation products are at low or no cost, they can compete with commercial ones. The benefits are related to the identification and development of something that is missing in the market and distributed within the networks and beyond.

Because of the inherent social and creative nature of the UIN, the research on tools and techniques for their observation and analysis is challenging and needs to explore human-human and human-computer interaction. Thus, the research questions revolve around suitable methodologies for UIN in order to observe, analyze and measure objectively, accurately and precisely these interactions and innovations. Two case studies, Daz3D, and Linux Dell and IBM cooperation present some research challenges about the community of practice and interface used.

## 2 UIN Case Studies: Daz3D and Linux

Von Hippel [1] suggests that User Innovation Networks (UIN) can appear in different forms; however, there are three UIN definition criteria: (1) at least some users have

sufficient incentive to innovate, (2) at least some users have an incentive to voluntarily reveal their innovations, and (3) diffusion of innovations by users is low cost and can compete with commercial production and distribution. Sometimes only the first two conditions exist; however, if such innovation proves to be of general interests and improvement occurs can attract commercial manufacture and distribution of innovations. It is difficult to follow the UIN trails as these processes evolve in time and demand different methodological approaches, from ethnotechnology [2] to social networks analysis and qualitative and qualitative measurements.

UIN paradigms now exist as the Web 2.0 collaborative state of mind and technologies facilitated global interaction and co-working. Examples come from the Daz3D modeling community and Linux implementation in Dell and IBM systems.

## 2.1 DAZ 3D™

DAZ 3D™ (<http://www.daz3d.com/>) is a corporation and community of practice [2] with users playing different roles. DAZ 3D™ strives to bring 3D art closer to the everyday user/artist by delivering the highest quality digital 3D content and software at the most affordable prices. The aim is to develop exactly what the users want by cooperation rather than being restricted to available marketplace choices. DAZ 3D™ users participate in the network design and build innovative products for their own use as well as reveal their designs to others. Those others then replicate and improve the innovation that has been revealed and freely reveal their improvements in turn – or they may simply replicate the product that has been revealed and adopt it for their own, in-house use. Other users can make comments in the available discussion forums.

Other than selling their products, DAZ 3D™ also works closely with third party artists and offers an online publishing program through which these artists can make their own creations available to the DAZ 3D™ customer base. A variety of software solutions designed to expand the market for digital content, including the increasingly popular DAZ Studio software application. DAZ Studio removes the barrier to entry for newcomers to the 3D industry, as it is offered free of charge. DAZ Studio provides an environment where users may take their favorite 3D assets and easily create art or animation for either recreational or professional endeavors. With a free, easy to use 3D tool, DAZ hopes to reach new industries and individuals that would otherwise be excluded. DAZ continues to focus primarily on creating digital content, and only develops items that help increase the demand for future DAZ digital content. With this in mind, DAZ continually develops new versions of their popular "Millennium" figures, as well as developing relations with the most successful third party content creators (Figure 1).

## 2.2 Linux

Linux is a generic term referring to Unix-like computer operating systems based on Linux kernel. Their development is one of the most prominent examples of free and open source software collaboration; typically all the underlying source code can be used, freely modified, and redistributed by anyone under the terms of the GNU GPL and other free licenses (source: <http://en.wikipedia.org/wiki/Linux>).



**Fig. 1.** The front-page leads to 4 options: 3D Models, 3D Software, Community and Support. Each product displays the image of the product as such, the vendor/creator, and a wiki open to all members and a share option at the bottom. As the wiki was added recently it created a more focused production of models based on the actual users/customers’ needs. Thus, user costs can be significantly lower because of the joint problem-solving work of innovation developers. Such content is located in the user sites and discussions as ‘user content networks’.

Linux has been used lately from commercial companies after customers’ demand. Dell, suffering market share losses to top PC seller Hewlett-Packard, tried to build its direct ties with customers. Dell used IdeaStorm, a website launched in February 2007 to allow Dell to investigate which ideas are most important and most relevant to the public (Figure 2):



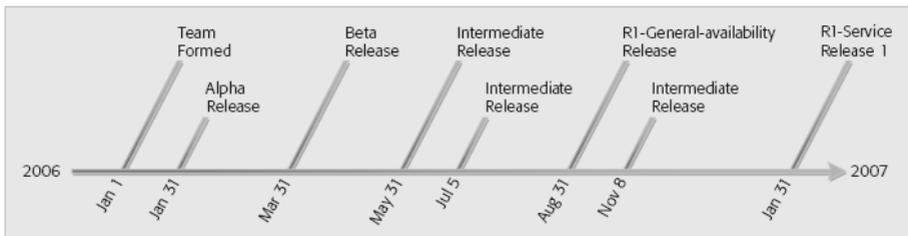
**Fig. 2.** Ideastorm

As with DAZ 3D™, Dell users can choose from: Shop, Support & Participate. The customers can make suggestions and vote on their own ideas. For example, some of the most popular ideas were:

- Add the Nvidia download driver page on driver and download page.
- Sell Ink Cartridges at Local Retail
- Use Linux
- Put Ubuntu on the list of operating systems when building a PC

Linux-based PCs was an "overwhelming" request from the IdeaStorm site. Therefore, of those who wanted Linux, 80 percent came back and said Ubuntu. Then Dell validated the Linux request through its own research. In May 2007, just 3 months after the customers' request, Dell started selling three computer systems with Ubuntu 7.04 preinstalled and Dell's scores were back on the rise.

A similar cooperation was between Linux and IBM. As IBM researchers stated, Real-time Linux brought significant changes for the enterprise and had a significant impact on the internal processes and role of the Linux Technology Centre (LTC) within IBM. It was one first of major cooperations between open source and production development communities by merging of real-time technologies into enterprise systems and Java. The cooperation between the team members was conducted with the use of open tools and a distributed development model mirroring that of the open source community. The following figure presents the production line (Figure 3):



**Fig. 3.** Project Release schedule [3]

From an IT Project Management viewpoint, the two communities had to work nine months before the general availability date of the product, with several intermediate releases planned. This was complicated because of the feature requirements, stabilization and iterative testing; in addition, some lightweight tools and processes were needed to leverage the existing LTC infrastructure. The IBM researchers identified the problem of archived broadcast communication. Thus, they had to mirror the development methodologies of the Linux kernel community, before changes are committed to the source repository, the patch (along with a detailed description, justification, and "signed-off-by" line) must be sent to the development mailing list. Using the LTC mailing list tools, they created the requisite user, development, and announcement lists typical of open projects.

Testing and validating releases was essential part of the IT Project Management process. Therefore, the team members had to review and acknowledge critical fixes; one of them should have been the team leader. Other than ensuring correct reviews, this process created a community narrative in the form of the archive on members' opinions and tests, history of changes as well as comments on usability. An internal LTC wiki was used for bugs and atomic features (i.e., very specific features that are largely self-contained), taking advantage of the existing LTC Bugzilla bug-tracking system (<http://www.bugzilla.org/>).

Nowadays, IBM supports Linux on all IBM servers, storage and middleware, offering the broadest flexibility to match your business needs with over 600 developers in the IBM Linux Technology Center working on over 100 open source projects in the community (<http://www-03.ibm.com/linux/>).

To conclude, it appears that UIN are multifaceted ecosystems involving computing, marketing and human networks. They have many benefits for the open source as well as for every production and innovation community: (1) they improve the reputation of the product and the community; (2) they provide patterns that suggest the critical ingredients required to grow, nurture, and sustain innovation hubs [4]; and (3) they advance current level of development.

Such complex ecosystems create interface design challenges.

**UIN Interface Design.** There are several interaction design challenges about the UIN interface design as the technology is not evolved enough to support such collaborative production. Interface design not only needs to support community building, but also to create an archive of the production trail, from design and development to marketing, sales, feedback, idea management, evaluation and statistics. For example, there are four sections in DAZ 3D™: Home, 3D models, 3D Software, Community & Support. In the community section, there are discussion forums, galleries, contests, and ArtZone. Figure 4 depicts the forums:

The screenshot shows the DAZ 3D forum interface. At the top, there are navigation tabs for HOME, 3D MODELS, 3D SOFTWARE, COMMUNITY, and SUPPORT. Below the navigation is a search bar and user information. The main content area is titled 'Product Suggestions' and contains a table of forum topics. The table has columns for Topics, Replies, Author, Views, and Last Post. The topics listed include 'Victoria Wishlist...', 'Millennium Kids', 'Wishlist for Alko 3.0 & Hiro', 'Millennium dragon wish list', 'Michael Wishlist...', 'Stephanie Wishlist...', 'OFFICIAL antiTate/antiBlock REQUEST THREAD', 'Freak Wishlist...', 'the Girl Wishlist', and 'David Wishlist'.

Topics	Replies	Author	Views	Last Post
StickY: Victoria Wishlist... [ 0 Goto page: 1 ... 20, 21, 22 ]	422	[REDACTED]	35531	29 Jan 2009 23:33 [REDACTED] [0]
StickY: Millennium Kids [ 0 Goto page: 1 ... 12, 13, 14 ]	267	[REDACTED]	29010	25 Jan 2009 21:02 [REDACTED] [0]
StickY: Wishlist for Alko 3.0 & Hiro [ 0 Goto page: 1 ... 25, 26, 27 ]	526	[REDACTED]	34544	03 Jan 2009 07:17 [REDACTED] [0]
StickY: Millennium dragon wish list [ 0 Goto page: 1 ... 8, 9, 10 ]	181	[REDACTED]	21704	02 Jan 2009 06:06 [REDACTED] [0]
StickY: Michael Wishlist... [ 0 Goto page: 1 ... 17, 18, 19 ]	379	[REDACTED]	29381	26 Dec 2008 03:27 [REDACTED] [0]
StickY: Stephanie Wishlist... [ 0 Goto page: 1 ... 4, 5, 6 ]	111	[REDACTED]	16293	24 Dec 2008 23:55 [REDACTED] [0]
StickY: [ Poll ] OFFICIAL antiTate/antiBlock REQUEST THREAD [ 0 Goto page: 1 ... 8, 9, 10 ]	181	[REDACTED]	9285	01 Dec 2008 19:26 [REDACTED] [0]
StickY: Freak Wishlist... [ 0 Goto page: 1 ... 13, 14, 15 ]	298	[REDACTED]	24478	25 Sep 2008 09:11 [REDACTED] [0]
StickY: the Girl Wishlist [ 0 Goto page: 1 ... 8, 9, 10 ]	186	[REDACTED]	32481	08 Sep 2008 06:23 [REDACTED] [0]
StickY: David Wishlist [ 0 Goto page: 1 ... 8, 9, 10, 11 ]	214	[REDACTED]	23239	10 Mar 2008 20:04 [REDACTED] [0]

**Fig. 4.** In DAZ 3D™ Forums, the PHP based forum only displays basic information without providing qualitative and quantitative drilling into the content at a glance, which would have been extremely useful and practical for the users. The same case exists in design-build and marketing-R&D interfaces as they are separate and do not support or converge to an ‘ecological’ and organic environment. Thus, there are challenges for Human-Human Interaction, Human-Computer Interaction, IT Project Management and marketing as well as quality in research.

### 2.3 Quality in UIN Research

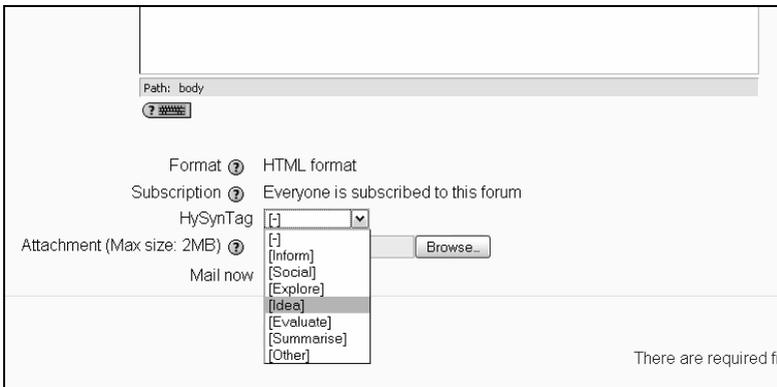
To now, there are not standard strategies to ensure UIN platforms direction and success with functions to combine strategic and business competencies, this is to generate and market content, community and product. If clear, focused plans with consistent and efficient decision-making processes exist, the interface can become more effective and UIN goals are achieved. Conducting research in UIN enhance the ability to use, evaluate and synthesize ideas from multiple peer-reviewed sources. Based on the power and usefulness of interactions, different research approaches can render information to faster interpret information, find trends, patterns or correlations to assist in the "wisdom of the crowds".

The methodologies we propose for UIN online research are considered to utilize triangulation and inter-rated agreement to achieve validity and reliability. The quantitative and qualitative approaches are the questionnaires, interviews and focus groups, tools and techniques for multidimensional analysis in discussion forums to observe and analyze UIN users using a Collaborative Creativity analytical framework [5, 6]. Social Network Analysis (SNA) is suggested as the third side of the triangle that defines the location of the individuals as a virtual and interaction space.

Because quantitative and qualitative approaches as well as log files analysis have been explored in great depth, this paper will focus on Hybrid Synergy collaborative creativity framework and SNA utilized in UIN.

## 2.4 Hybrid Synergy

Previous research on ways to support and evaluate idea generation in groups was anchored in collaborative creativity as a qualitative research framework [2, 5]. We have developed an analytical framework to attach qualitative attributes to online discussions and e-learning in particular. As User Innovation Networks consist a community of practice and thus, a learning community we propose the Hybrid Synergy to be used as a collaborative creativity framework. Hybrid Synergy was found useful as an analytical framework to guide, analyze, evaluate and consequently enhance collaborative creativity via argumentation. More particularly, the members follow a series of non-linear stages, in a rather spiral direction, in their online discussion. These stages are depicted in Figure 5:



**Fig. 5.** The Hybrid Synergy framework for collaborative creativity is depicted in a Moodle tool [5, 6]. The first step refers to mere information provision, the second to the social aspect, these are the social interactions, the third and fourth to the exploration of ideas and the provision of ideas as such, the fifth to their evaluation and assessment and lastly the sixth step to a meta-cognitive aspect with summaries and assignments. A prototype tool anchored in Hybrid Synergy has been developed under development base don user-centered design. Although the Hybrid Synergy framework has been fully evaluated [e.g. 2] the tool as such has not been fully evaluated and redesigned yet [5, 6].

## 2.5 Social Network Analysis for UIN

Social interaction within User Innovation Networks occurs as discussion and original content contribution within forums, bug/enhancement trackers, blogs and wikis. Social Network Analysis (SNA) is a technique used to map and measure the interaction that occurs between participants within a network. SNA within web-based collaborative tools is inferred from post-reply data. Visualization techniques [7] can be used to identify key participant roles and the types of interaction that occurs between participants. For example, Welser et al [7] utilized visualization and analytic techniques to identify the signatures for an ‘answer person’ and a ‘reply magnet’. An ‘answer person’ is a participant that regularly answers direct questions but does not participate in ongoing discussion. A ‘reply magnet’ on the other hand is able to initiate ongoing discussion. In this way, SNA provides insight into the type of participant interaction that occurs in both well functioning and floundering UIN. SNA also plays an important role in determining the success of techniques used to foster and cultivate interaction within emerging and non-functioning UIN.

Although the ability to analyze, visualize and categorize the social interactions that occur in User Innovation Networks is essential to foster creativity and innovation within a network, numerous challenges exist. User interaction is usually split across a range of commercial and open source web-based collaborative tools that don’t readily expose post-reply data. In order to perform SNA across the entire network, data would need to be collated from all tools. It is therefore difficult to view the interaction that occurs in individual tools and the UIN ecological system as a whole. In many instances the relevant data for SNA can only be extracted by performing direct database queries. The release of such information is at the discretion of the individuals with web and database server access, and is rarely made available to UIN participants and researchers.

Emerging semantic web technologies can however enable the exposure of social data within UIN, thereby facilitating analysis and visualization. The Semantically-Interlinked Online Communities (SIOC) project has developed an RDF-based semantic ontology standard that supports social data exchange between web-based collaborative tools [1]. SIOC has been implemented as an add-on for Drupal (CMS), Wordpress (Blog), vBulletin (Forum) and phpBB (Forum). The SIOC semantic model is able to represent users, forums, post-reply threads and websites. Boardscape [8], which currently utilizes SIOC is described as a “world of boards” as it aggregates data from multiple web-based forums. sioc.me provides interactive 3D visualizations for 10 years worth of SIOC exposed data from the boards.ie website (Figure 6).

The true potential of SIOC however lies in the fact client-side tools which UIN participants and researchers can easily install, will be able to detect, analyze and visualize embedded SIOC data. Semantic Radar is Firefox extension that is able to detect and display SIOC data in human readable form. The SIOC standard is therefore able enhance social data exploration within the web-based tools utilized within UIN.

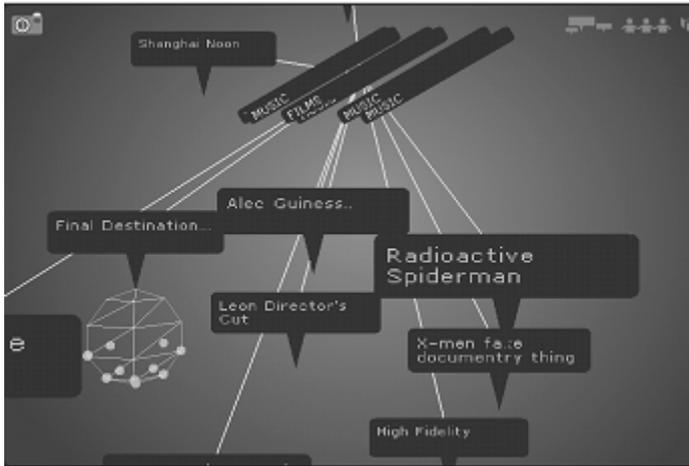


Fig. 6. A sample visualization from <http://sioc.me>

Using <http://sioc.me> to explore conversation threads within the "Films" forum on <http://boards.ie> in real time rendered to an interactive 3d space that the user can explore by clicking on threads. The sioc.me website provides visualizations for both the SIOC and Friend of a Friend (FOAF) semantic formats. Sioc.me retrieves the SIOC data exposed by the boards.ie website and displays forum threads within an intuitive 3D environment that users can interactively explore.

Such real-time qualitative and pictorial information can be combined with quantitative information on one visualization.

### 3 Conclusions and Future Trends

User Innovation Networks create great challenges for Human-Human and Human-Computer Interaction research but also to other disciplines not discussed here. UIN provide a new venture investment cycle creating and profiting from technology.

Users Innovation Networks suggest that in most cases initial developers and later consumers collaborate in a more simple or extreme way to produce consumer goods. They can have various forms depending on the initial targets of the network members and as von Hippel [1], following Wellman and colleagues [9], suggested may or may not form a community of practice i.e. developing a sense of belonging, and social identity. No matter how the members build the network, fostering positive attitude and relationships between them is essential for all production parts [10].

Consequently, 'extreme' collaboration projects are built on cooperation with people from diverse backgrounds and experiences as well as disciplines. It fosters co-creativity and innovation in unexpected ways as equality and diversity between co-workers allows serendipitous cross-fertilization of ideas to occur. The more coherent groups employ international project management and idea management tools and techniques to enhance international communication and collaboration. Time differences seem to make some forms of communication impractical, such as synchronous

communication. Specific ways of working may occur as for example embracing the 'patch' culture in the Linux case. This means that new convergent interfaces are needed to support communication and co-working as well as marketing and sales based on a trail/process as well as final productions.

As for future trends in regards to Human-Computer Interaction, agile software development in combination to usability testing and traditional software development approaches are crucial to meet the ever-changing needs of such user-centered production. Interfaces need to provide qualitative information visualization for locating, distinguishing, accessing, comparing and evaluating resources as the first step. The second step is related to applying, communicating and synthesizing previous information for innovation by adding new knowledge to UIN; real-time information visualization supporting different research methodologies seems to be the key. These two levels create great research and development challenges.

To conclude, User Innovation networks build financial and social capital by supporting collaborative creativity and innovation in all relative forms by the users. Other than the financial benefits, the most innovative users can be identified and supported; network members learn to accept diversity and appreciate the motives and drivers behind people's behavior and the ability to reconcile differences. In addition, UIN members are competent in communication and organizational skills, learning how to learn, motivating others, knowledge management and problem solving skills such as organizing things, working together for solutions, and coming up with good ideas with idea generation, idea sharing and idea discussion, all described as e-business skills.

Time-based, archive-oriented and trail-traced processes are not translated yet into coherent interface design principles as well as facilitate research. More research is needed to identify principles and standards to generate, design, develop and sustain User Innovation Networks. Such principles will aid in the development of a new business model with direct implications and requirements in human-computer interaction research.

## References

1. von Hippel, E.: Horizontal innovation networks- by and for users. MIT Sloan Working Paper No. 4366-02 (2002), <http://opensource.mit.edu/papers/vonhippel3.pdf> (last access, 02/02/2009)
2. Lambropoulos, N., Kampylis, P., Papadimitriou, S., Gkikas, A., Vivitsou, M., Minaoglou, N., et al.: Hybrid Synergy for virtual knowledge working. In: Salmons, J., Wilson, L. (eds.) *Handbook of Research on Electronic Collaboration and Organizational Synergy*, vol. 1, pp. 83–102. IGI Global Publications, Hershey (2008)
3. Hart, D., Stultz, J., Ts'o, T.: Real-Time Linux in Real Time. *IBM Systems Journal* 47(2), 207–220 (2008), <http://www.research.ibm.com/journal/sj/472/hart.html> (last access, 02/02/2009)
4. Andonian, A., Loos, C., Pires, L.: Building an innovation nation. In: *What Matters*. McKinsey & Company (2009), <http://whatmatters.mckinseydigital.com/innovation/building-an-innovation-nation> (last access, 03/03/09)

5. Daskolia, M., Lambropoulos, N., Kampylis, P.: Advancing Collaborative Creativity in the context of Greek Teachers' In-Service Training in Environmental Education. Poster paper accepted for 8th International Conference on Computer Supported Collaborative Learning CSCL 2009 (2009)
6. Lambropoulos, N., Kampylis, P.: Fostering Collaborative Creativity and Metacognitive Awareness in e-Learning Framework – The case of Hybrid Synergy Tag Tool. Paper accepted for the International Conference of the Greek Association of Primary Education Teachers EEMAPE (2009)
7. Welser, H.T., Gleave, E., Fisher, D., Smith, M.: Visualizing the signatures of social roles in online discussion groups. *The Journal of Social Structure* 8(2) (2007)
8. Breslin, J.G., Kass, R., Bojars, U.: The Boardscape: Creating a Super Social Network of Message Boards. In: International Conference on Weblogs and Social Media (2007), <http://www.icwsm.org/papers/3-Breslin-Kass-Bojars.pdf> (last access, 20/02/2009)
9. Wellman, B., Boase, J., Chen, W.: The networked nature of community on and off the Internet. *IT and Society* 1(1), 151–165 (2002)
10. Lambropoulos, N.: Tools and evaluation techniques for collaborative e-Learning communities. Unpublished Research, Ph.D Thesis at the Centre for Interactive Systems Engineering, London, South Bank University (2008)