Crowdsourced Science and Global Scientific Amateurs

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Abstract

This paper will deal with of innovation in science and technology through new technologies and how amateurs are taking part in that innovation. We will study how amateurs are increasingly taking part in techno-scientific development through Information Communication Technologies (ICT). So we will give an account on the different approaches and case studies such as crowdsourcing and volunteering computing. Also we will assess the importance of different strategies, communities and practices to innovate social and technically. On-line games will be a good example of that Science 2.0. Some proposals such as the Wikinomics seem to understand market economy in a more human perspective, close to gift economy: markets are ways of collaborative innovation instead of fight and competition.

Keywords: crowdsourcing, amateur, gift economy, on-line games, volunteered computing, Science 2.0

Introduction: Innovation Questioned

> "It's about the emerging reputation economy, where people work late into the night on one creative endeavor or another in the hope that their community—be it fellow designers, scientists, or computer hackers—acknowledge their contribution in the form of kudos and, just maybe, some measure of fame".
>
> Jeff Howe *Crowdsourcing* (2007)

There are different voices claiming that traditional studies to understand innovation fail to give account of what is really going on in present connected societies. Several reasons may explain such statements; the appearance of new factors previously not regarded as important (von Hippel, 2005) and diverse societal sectors not yet studied. Some reports indicate how standard criteria are not able to render certain facts in innovation. Hidden sources, sectors not included under the usual, linear parameters and deep technological changes play an important role in today's innovation. All these factors together seem to expand the meaning of innovation beyond what old-fashioned experts used to understand. For instance it is important to see how sources for innovation come from social environments and not only from industrial sources based in techno-scientific research (Katz & Hicks, 1999, NESTA, Echeverría & Merino 2011). In fact, according to NESTA: "the innovation activities that

are not reflected in traditional indicators such as investments in formal R&D or patents awarded. Despite not being measured, hidden innovation often represents the innovation that matters- the innovation that most directly contributes to real practice and performance of a sector" (NESTA, 2011).

What is labeled as "social innovation" ranges sectors as varied as: "Self-help health groups and self-build housing; telephone help lines and telethon fundraising; neighborhood nurseries and neighborhood wardens; Wikipedia and the Open University; complementary medicine, holistic health and hospices; microcredit and consumer cooperatives; charity shops and the fair trade movement; zero carbon housing schemes and community wind farms; restorative justice and community courts. All are examples of social innovation – new ideas that work to meet pressing unmet needs and improve peoples' lives" (Mulgan, 2007). What happens is that maybe industry and technology are not meeting people's needs. But at the same time it may be the case that some groups of people are in fact meeting particular needs of industry and technology in certain cases. This may seem something unexpected but it can be traced back to the birth of Modern science. In its origins, amateurs were who funded the Royal Society (Shapin & Shaffer, 1988) and amateurs provided with interests, needs and questions that science tried to solve (Conner 2005, Smith, 2004). Today amateurs and professionals seem to blend again in different projects including scientific ones. In fact this mixture among professionals, scientists and amateurs have happened before. For instance amateur astronomy has been traditionally one of the research realms where individuals have been able to contribute outside scientific institutions to science. Birdwatching is also another example. But technology has empowered these trends beyond those relevant cases. There is a growing agreement on the idea that amateurs are playing an important role in the very process of present innovation, not only in social but also in techno-scientific realms. This is the case of life sciences and citizens as Bonetta (2009) presents it. What we are witnessing, and this is a motto along this paper is how traditional structures belonging to a previous society are changing. Industrial stereotype is under question because this model asks for large-scale capitals. Up to now large-scale investments permeated almost all social activities: from consumption to science, from economy to health. Now: "Social and technological change is pressing against the gate, barbarians are sieging the 20th society" (Howe, 2007). We can say that innovation is moving from the center to the peripheries. In fact this should be not so surprising. As said before, science and technology amateurs were who used to take care about bodies, cities and environment. Even more, maybe the distinction between professional and amateurs "is a question for privileged legitimacy" (Balsamo, 2011: 3).

Therefore there are different ways to look at innovation, for instance wikinomics

(Tapscott, 2006). Wikinomics can be defined as “the effects of extensive collaboration and user-participation on the marketplace and corporate world.” It includes features such as opennes, horizontal peering, sharing and acting globally. In the new version *Macrowikinomics* Tapscott (2010) tries to deal with the present situation of financial crisis. Social innovation is not only a way to boost economy but a path to go away from the crisis. Social innovation affects, according to Tapscott, different areas such as business, science and health (such as pharmaceuticals, see Ekins, 2010). Networking is what changes everything because allows interconnection and at the same time, as Yochai Benkler states (Benkler 2006), shows the end of old industrial model. The rise of networked society where information becomes a cheap commodity points out to another way of innovation. Enforced by law, patent and copyright is a serious obstacle to the free flow of information, and therefore innovation more and more difficult to achieve.

The Great Effect of Crowdsourcing

In 2005 Jeff Howe coined the word "crowdsourcing" to identify a peculiar way of interaction on-line: people collaborating to get a collective aim (Howe, 2006). This term is part of a larger collection of newly used terms belonging to the so called Web 2.0 culture such as “crowd intelligence”, “flash mobs” and similar. All of them have in common the use of social networks based on computer communication. On the other hand, crowdsourcing does not stop in the “world of bits” but also tries to reach the world of atoms, the world of real things. After 2005 there is a growing literature exploring the capabilities of that working-producing strategy. Somehow Alvin Toffler (Toffler, 1984) was the first to suggest how in a new economy model consumers would transform into producers. What Toffler maybe foresaw was the importance of what economists identify as a “network effect”: in a telephone network the use of each individual increases the total value of the network itself. An easy example to understand is Google. Users of Google add a value to the search engine anytime they use it (Benkler, 2006). But at the same time change in innovation is more profound. As a result, such as von Hippel sums up: “The ongoing shift of innovation to users has some very attractive qualities. It is becoming progressively easier for many users to get precisely what they want by designing it for themselves. And innovation by users appears to increase social welfare. At the same time, the ongoing shift of product-development activities from manufacturers to users is painful and difficult for many manufacturers. Open, distributed innovation is “attacking” a major structure of the social division of labor” (von Hippel, 2005).

Crowdsourcing refers to finding research resources out of companies and

research facilities in exchange of a reward. Associated terms for crowdsourcing are community based or distributed problem solving. Crowdsourcing calls for the hidden talent among employees, amateurs, institutions and other players in the game of generating knowledge. It ranges from technology to politics; Iceland had its recent constitution written by citizens in a wiki (Siddique, 2011). Free and open software are clear examples of how it is possible to generate professional software (OS and apps) inside non-structured industrial models (Howe, 2008). Now there are researchs on Ubiquitous Crowdsourcing because mobiles, tablets, 3G technologies allow a wider intervention (see Vucovic, Kumara and Greenshpann, 2010). But there is a difference between "community based"and "distributed problem solving", such as Innocentive, a company that provides crowdsourced problem solutions using "peer collaboration". One must be careful with the term because there are different proposals to identify crowdsourcing projects attending to "preselection of contributors, accessibility of peer contributions, aggregation of contributions, and remuneration for contributions". And some propose the existence of 19 different types of crowdsourcing (Geiger et al., 2011). Here economy is the main drive. Innocentive has solved more than 10.000 challenges in 2011 and has created a vast network of "solvers" scattered along the world. What Innocentive has proved is that there is another way to organize sound scientific knowledge. Now the scientific procedure does not consists into gather as much information about a problem and make sense out of it. In some cases it is easier to post the problem and let people find the solution.

Free Software, *Wikipedia*, and Kiva (crowdfunding microcredits) are examples of strong communities of practice where apart of a common task there is a real commitment for ethical values (Lakhani, 2005). That differentiates simple or informal crowdsourcing projects. Right now crowdsourcing is in the stage to see pros and cons. For instance, companies like Kraft or Nokia use crowdsourcing strategies to launch marketing campaigns. Kraft asks consumers about new ideas to package products and Nokia "lead users" to change mobile device designs. In a very low sense we can accept this is crowdsourcing instead of a better or more fitted way of marketing using new technologies. Another criticisms used against important communities of practice such as Wikipedia applies to crowdsourcing as well. One of the most popular examples of crowdsourcing projects went on graphic design. CrowdSPRING was launch as a Web 2.0 contest on graphic design for amateurs. There was a small reward (about 200 $) if a posted design gets importance so very few took seriously what was labeled as a "poor Web 2.0 project". Right now there are more than 80,000 amateur designers contributing. On the other hand professional graphic designers reacted a little bit late creating NO!SPEC a web site to "educate the public about the speculative (spec) work." Ideas behind NO!SPEC is that amateurs are impoverishing sound and

professional graphic work and as a consequence the product quality goes rapidly down. Howe sums up very clearly what is going on in this quarrel: “The controversy currently embroiling the design world both echoes the one that consumed photography a few years ago and prefigures the conflicts between professionals and amateurs sure to arise in other fields as the basic crowdsourcing model continues to migrate” (Howe, 2008, iv). Somehow this line of criticism is by no means new: free software suffered the same criticsm along with Wikipedia and Open Access publishing as well.

Is all about Sharing and Curiosity

Right now there are many examples showing how people organize themselves outside corporations and institutions, provided a suitable technology. What technology allows participants is to be able to co-manage the product during the whole process. For certain activities, money is not the unique reason to work because gift economy serves as a way to share, the usual narrative about markets does not explain all the world exchange transactions. There existsn a expanded gift economy that needs to be taken into account (Lafuente, Alonso, 2011). One interesting case is the search for Mersenne’s numbers, a mathematical oddity for general public. But volunteered computation has been able to reach those Mersenne’s prime numbers that are compounded about ten million digits. A project, GIMPS (*Internet Mersenne Prime Search*) organized in 1995 a network using volunteer’s machines to process number data in order to find the prime number series. Up to now the site lists 47. The biggest one was discovered in july 2010; $2^{43112609}$-1 and can be downloaded as a file occupying 6,14 Megabytes. The Electronic Frontier Foundation offered an award of 100,000 for the first prime number containing at least 10,000.000 cyphers. The winner was Edson Smith at the California University in 2008. What is interesting to note is the project reached in 2005 70.000 computers and now they are 408,127 CPUs running daily and the sustained capability of computation is 55.782 TFLOPs per second, surpassing many commercial supercomputers. What makes hundred of thousands people share and participate in that project? It seems that Mersenne numbers supposedly do not have a direct application in reality. In fact GIMPS offers reasons that have little to do with money: “learn more, to collect rare and beautiful items, tradition, glory… they claim, very few for the different awards (Electronic Frontier Foundation offers 150,000 $ for the 100 million and 250,000 for the first billion digit prime number)”. These reasons sound plausible but maybe there is another one: amateurs can participate in a highly scientific project, they can feel contributing to “pure science”, knowledge for knowledge’s sake, in a time where application seems to embrace all possible research. As the members of GIMPS state: “Their greatest contribution to

mankind is not merely pragmatic, it is to the curiosity and spirit of man. If we lose the desire to do better, will we still be complete?" An Spanish contributor confessed his lack of knowledge both in mathematics and computer science but still he found attractive the idea of letting some unused power of his computer to work for GIMPS.

Several projects like SETI@home, based on distributed massive computing, show how big is the power people have right now and how it can be used in a project. SETI (Search for Extraterrestrial Intelligence) is a landmark in amateur distributed computing. Carl Sagan proposed the search of intelligent transmissions in the outer space in 1985 but suffered different difficulties due to lack of support and money. In 1995 David Geyge proposed the idea of using a virtual supercomputer for Radio Seti and in 1999 the project was on line. In 2005 SETI@home became part of BOINC (Berkeley Open Infrastructure for Network Computing), an open-source software platform for computing using volunteered resources. In fact SETI is one of the largest projects based in P2P, the same technology used for banned or prosecuted applications such as Napster, devoted to music or Kazaa and Emule (file exchange, applications and contents among members of different communities). In fact those communities exists thanks to that software. This is what unites and allows them to share and create common values although prosecuted by copyright holders. SETI@home has attracted the interest of millions of users that give for free their computing time specially using sleep time mode. The way to participate is quite simple; a screensaver composed of a bunch of applications automatize several functions to process information packets and file exchange. These processes do not require any work from the donor. The result is quite impressive: 30,638,812,925 daily results whose required time would equals to a machine working 2,433,979.781 years. Popularity is also quite impressive. In 1990, 20 countries were involved but now there are 234. In December 2004 226 teams supported SETI distributed computation and now they are 58,709 using 2,844,052 computers. Computer power is about 499,902 TeraFLOPS per second.

The equivalence of money –teams, computing time, human time, electricity- is impressive. Studies consider the value on 43 $ millions. Thanks to that network SETI is probably one of the projects better based today. It shows also the old idea of popular power, something that is not just a fantasy given the results. Three different elements are converging: good ideas, collaborative spirit and non-profit aims. SETI asks for computing time but also creates something more complex: it is part of a kind of science (MacRobert, 2005) together with the rest of BOINC projects such as Climateprediction (global climate change), Einstein@home (gravitational waves), LHC@home (atomic particles), Predictor@home (proteins). Those do not have the impressive figures that SETI posses but they have in common a multilayered way of doing science that

includes amateurs, volunteers, research institutes, astronomers and scientific society. SETI collaborators also become something a little bit more complex; they become SETIzens, a community based on technology integrated by donors (mainly young males, 93%) who tries to spread the human home all around the universe and believes that extra-terrestrial intelligence will be one of the biggest scientific discovery. SETI is science and has little to do with sects such as raelites or elohimites, because there is neither supreme leader nor initiation rituals. Features better defining SETIzens are their enthusiasm for technology, their liking for Sci-Fi movies and the will to fulfill a common good.

Why SETI is so popular and not other projects maybe more urgent or down to earth? In fact there are dozens of projects inside BOINC, ranging from mathematics to proteomics. Among them projects of smaller scale such as Nutritious Rice for the World shows how it is possible to succeed in research directly related to improve human condition. According to the organizers: “the objective of this project is to predict the structure of proteins of major strains of rice. The intent is to help farmers breed better rice strains with higher crop yields, promote greater disease and pest resistance, and utilize a full range of bioavailable nutrients that can benefit people around the world, especially in regions where hunger is a critical concern.” Using volunteered computing, this project was able to finish two months earlier than planned and all the effort was shared among the researcher team, IBM (software providers) and volunteers.

Among other technological people such as nerds and geeks, SETIzens are qualified as not too involved volunteers in computing grid. But volunteered computing is only a part of how amateurs can get involved with research projects. Brute force, using Montecarlo methods to solve scientific problems is only one possibility. But there are different user’s involvements according to diverse projects. For instance NASA wanted to go beyond passive help and launched Clickworkers, a project to cartography Mars’ surface. This kind of work may sound boring, the kind that graduate students make. In fact the first phase (2000-2001) was to analyze images provided by the Viking, images already analyzed by NASA. But the idea behind was to answer two interesting questions. First: Is the public ready, willing, and able to help science? Second: Does this new way of powering science analysis produce results that are just as good as the traditional way? First question was affirmative: 85,000 volunteers peered upon NASA’s photographs. The second was affirmative too: according to NASA’s experts, work done by volunteers did not differentiate from an expert in the same field for two dozens of years. There is a problem with scientific data; NASA is gathering Martian images from 1960 so the collection is so big that scientists cannot have a complete analysis by themselves and human common sense and attention is required so computers cannot make the work. Being both questions affirmative, NASA went on with more

sophisticated projects. In 2001 NASA provided with images from the Mars Global Surveyor, never analyzed before and in 2009 launched a web site with the name “Be a Martian!” where volunteers can count craters. Of course Mars has the glamour of a close planet that captures people’s imagination and this is perhaps what explains the success of Clickworker. But again these non-profit scientific projects calls for something that is not money, no direct gain from work. Also there is an important value: community. In fact, Mersenne, SETI, Clickworker are web sites that gather many individuals sharing experiences through wikis, forums and other devices. The question is what was first if the community or technology. What it is clear is that technology allows these communities to gather and collaborate. And the question is how far they can go summing up efforts.

Let’s play

Connected society teaches us how knowledge is more and more out of formal patterns such as institutions or hierarchical structures. In fact there are human activities able to create and transmit knowledge that do not follow classical patterns. Clearly some formalities remain such as publishing in high quality scientific journals if somebody has to be credited into de scientific community. But some propose a different approach that does not put English or being knowledgeable in Biology as basic requirements if you want to contribute with something really important in that field. It is enough to master a game like FoldIt. Games are an essential part of our culture, as Huizinga reminded us (Huizinga, 1984). If we describe human being as “homo faber” we have to add immediately “homo ludens” as well. Understanding what is playing, what is a game leads us to a huge literature (Callois, 1962; Echeverría, 1999; Bogost, 2006). But some principles remain more or less stable: it is a free activity, has its own reward in itself, follows rules and detaches players from reality. Science has some common elements with games: it requires freedom, following rules, and detaches individuals from commonly accepted reality. Games and playing go with all human activities and networks are not an exception as it happens with science.

Video, computer and on-line games are targets for numerous criticisms ranging from addiction to sexism and violence (Wacjman, 2004). Cyberculture exhibits rare groups such as video game players with a quite bad reputation (close to role game players or reality show addicts). Sociopaths, fanatics or psychos are some ways to classify them. For the public they are close to nerds; techno-maniacs, self absorbed and scruffy. But their capacity to work on line may change how they are perceived. On line work is surprising everybody and improving how are perceived. On-line games are changing social perception. But at the same time on line games are an important

industry that generates huge revenues. In fact production of computer graphics for games are considered a strategic innovation sector given that 147,000.000 U.S. people play videogames. Some figures give account of the extension of that phenomenon. Halo 3 has different forums where up to now the exchange of messages is about 2 million and 150,000 different discussion themes. According to Wikia –the wiki devoted to on-line games- game wikis are the biggest, coupled with Star Wars and Star Treck. World of Warcraft and Ever Quest (for MMORPG; massively multiplayer, on line role player game) are wikis number 2 and 3 with respectively 81000 and 49000 articles. Halopedia, one of the most active wikis among more than one thousand, gather more than 6030 articles on shared knowledge about the game that have gone through a million times edition. Halo is one of the most proactive on-line games. All the time and mental effort that this numbers represent make wonder if there is a way to transform it in something that can have some use in other fields without losing its appeal. But there are different types of games and among them Games with a Purpose (GWAP). Those try to entertain players but, at the same time confront a scientific challenge.

FoldIt is one of the most refined games that unite entertainment and scientific knowledge. Proposed as a free multiplayer on-line game FoldIt does not deal with rescuing princesses or scoring goals or killing aliens. Downloading FoldIt is for free. According to Science Daily (2008) one of the trendiest ways to play on line is folding proteins. Developed at the Washington University is maybe one of the most successful scientific games up to now. The idea is that games can contribute to improve health and expand knowledge too. FoldIt falls under Huizinga's category of serious and fascinating games that adults also use to play. This kind of games tries to take advantage of youngsters' imaginative power and ability to concentrate. Although FoldIt is a game, some solutions are under the category of cutting edge science contributions. This is important: FoldIt is not a didactic game it is closer to hobbies, it requires players to obtain scores visualizing the most stable tri-dimensional for a chain of different objects. What is inside this game is important: proteins are responsible of cellular life and at the same time are in charge of building up living beings. Proteins are behind almost everything that happens inside the body: they transmit signals between two cells, balance the biochemistry, transfer nutrients, regulate the catalysis of chemical reactions or the division of big molecular chains. Our body is compounded of trillions of cells and proteins are in charge to make each of them behave properly. Every protein is a more or less long chain of amino acids (there are twenty different). Smallest proteins have about one hundred amino acids and largest ones are about ten times bigger. The question is that chemical behavior; its bodily function does not depend only on their composition but also on their tridimensional structure. In the same way a screwdriver does not work properly if it does not have a handle and an edge at its top, proteins do

not work if they do not fold properly, do not function as they should. In the same way each piece of a puzzle has a place and only a place to fit, it happens with proteins.

Accepted this then it is easy to understand the purpose of FoldIt. Illnesses mean that something stop functioning correctly or in other words, some protein is not working properly because either the body does not produce it or it is incorrectly fabricated. “Working properly” implies that since proteins are the engines for cell activity, that implies proteins going through the body carrying some information for cells. That information says how the cell should work. “Carrying information” means to join a cell and “leave a chemical load”, similar to deliver a message, sweeten a coffee, start a fire, join two bodies or plug a flow. Probably this oversimplifies a more complex biological reality but is how FoldIt is explained; the rationale behind the videogame. Lets suppose a layman knows the structure a protein needs to heal a patient who does not produce it. The layman does not know the architecture of that protein but he knows the rules needed to obtain it. Rules are not too difficult to understand, the game has an intuitive interface. So what is needed is layman trying different possibilities. Some of them correspond to known architectures, some of them not. What the player has is some graphic commands to build up a three-dimensional structure from a linear set of objects; the goal is to achieve three-dimensionality following the rules of the game that are the very rules of biochemistry. From that the structure must be able to join perfectly the cell (cell itself is a three dimensional structure with cavities, protuberances, depressions and so on). If this is achieved, according to *Technology Review*, it is possible to heal different illnesses. AIDS, Alzheimer or malaria are among the targets that FoldIt may solve.

Of course possibilities are huge and the three-dimensionality opens up billions of paths so it is an extremely complicated game. But what is interested is that players become amateur scientists. Baker, one of the game designer stated “that was alway our mission, to take genetics into the people and make it less white coat and more street clothes” (Balsamo, 2009). In fact FoldIt comes from a previous project belonging to BOINC such as Rosseta@Home. Brute force was used to find out different ways to fold proteins. Volunteers would get a screensaver and watch how the protein folded but some remarked how inefficient was the program and complained because they could not intervene with common sense modifications to improve the procedure. So, parallel to NASA’s Clickworker, there was the idea to have a videogame to get people involving effort and time because people can make this task better than a PC. Of course this requires time and effort but the idea is to amuse people while playing science. In exchange, these people contribute to scientific development. On line games represent an opportunity for various sectors and not only for business. From 2000 up to now Games for Health has held 7 annual congresses to explore possibilities with “serious

games". Even insurance companies seem to be interested in learning about health through playing. Now there is an expansion through the appealing title of "Ludica Medica", trying to explore and make better health games.

Apart of being a wealthy business with substantial risk capital and possibilities in marketing and selling, games are new ways to access science. Traditional or digital, every game tests people's capacity to confront new problems and find new solutions. If player multiply and play on line possibilities grow geometrically. Players share knowledge, strategies, tricks and affinities. New phenomena such as the massively multiplayer online games (MMOG) show unexpected features such as self-organization, a kind of "gaming citizenship" and extreme democracy (Freire, 2005). Player may ask for changes in the rules of the game and that asking would lead to open source software. As Einstein used to say: "games are the highest way of research". What this statement implies is that a good game is a collective, exploratory, tentative activity, always open to the search of best solutions. If this is true games are very close to scientific activity. Games and science share iteration of proof, control of certain behavior patterns and defining a system of reward and sanctions to fix best practices and identify what actions lead to success (Jenkins, 2006). Temptation is to rebuild scientific practices as an open game needed of collaborative communities to design working strategies and share analysis of results. Is this possible? According to McGonigal, it is. In 2007 McGonigal proposed to the American Association for the Advancement of Science (AAAS) such model. Then pop culture and science approach. The idea is not to "scientify" games but to make science to speak the language of games. X2 Project is a game proposed by the National Academy of Sciences, along the line of FoldIt: player can modify rules on the go.

According to Thomas Kuhn, changes of scientific paradigm are based into broaden the number of actors and the acceptance that scientific rules are more or less solid conventions. Maybe this trend could reverse the tendency in science denounced by Alvin Weimberg born after the 2th World War, what is known as Big Science. Journalitis, moneyitis, and administratitis seem to define a science that has forgotten the ideals of knowledge (Capshew & Rader 1992). Maybe the old ideal of science for science's sake could arise from this inclusion of new actors and practitioners.. Resources, organization, new instruments, validation and sharing are different from scientific traditional patterns. Media, actors and networks are transformed, recreated, recruited in different ways. In sum, almost every aspect of scientific work seems to be modified and therefore we can speak of a new global politics of knowledge (Lafuente & Alonso 2011) and we can ask are we witnessing the end of expertocracy?

Conclusion. Where are we heading?

The mentioned examples may point out a new way of doing science. There are three levels according to user's implication: volunteering computer, active collaboration and gaming as a way of deeper involvement. Open and participative contexts may help to change how illnesses are treated, how science is done today and how we explain ourselves what is science. We do not know yet if we are having fun while making science or we make science to have fun. Science is something more than profession it is also a vocational and fulfilling activity. This is why playing is one of the main factors to mobilize and coordinate intelligence, experience, abilities, wisdom and imagination that humanity possesses and that affects science too. What Pierre Levy (Levy, 2004) identifies as collective intelligence also has to do with scientific research. Science becomes and activity that has meaning in itself, attractively enough to recruit amateurs. Then what we have learned from Big $cience –only applied research has meaning- becomes false: people like to discover things that are not of immediate use such as Mersenne's numbers, Martian topography, or extra-terrestrial intelligence. Therefore pure curiosity is still one of the most important incentives for human mind. This should be understood as the shift from an industrial to another informational paradigm. Old ideals to engage public and amateurs in science –beyond pure popularization or wonder- may have an opportunity here, may have the possibility of producing techno-citizens (Lafuente & Alonso 2011). Of course there is room for criticism. As Adar points out some of these projects seem to be "mechanical turk research" where individuals disappear in favor of the project leaders. Other criticism goes on, as said before, about the quality of data and work obtained from those "mechanical turks". But it seems that so far the quality is at least at the level of undergraduate students (Berhend et al. 2011).

What last decade has shown is the incredible potential of that "collective intelligence" or crowd potential. The task now is how to transform that potential in something positive. According to McGonigal : "As the leading edge of research, industry, politics, social innovation and cultural production increasingly seek to harness the wisdom of the crowd and the power of the collective, it is urgent that we create engaging, firsthand experiences of collective intelligence for as wide and as general a young audience as possible. Search and analysis games are poised to become our best tool for helping as many and diverse a population as possible develop an interest and gain direct experience participating in our ever-more collective network culture."(McGonigal 2007). There have been some proposals to reconstruct a better scenario where that wealth can be understood in a more friendly way. For instance the "Cluetrain Manifesto" tries to understand economy in different perspectives; market is defined as a continuous conversation instead of a battlefield. Before the era of the web

2.0 (in 1999) some experts concluded the need to redefine our economic environment. In 95 points they try to describe the new scenario where economy should be considered: “A powerful global conversation has begun. Through the Internet, people are discovering and inventing new ways to share relevant knowledge with blinding speed. As a direct result, markets are getting smarter—and getting smarter faster than most companies”. Interestingly enough the idea of collective intelligence, of community appears: “34. To speak with a human voice, companies must share the concerns of their communities. 35. But first, they must belong to a community”. But the issue, again, does not end in increasing productivity through crowds, there is more. What we are witnessing is the possibility of a more virtuous society, to introduce some ethical values in this globalized world (Benkler, Nissebaum 2006) following the communitarian ethics proposed by Alisdair McIntyre (McIntyre, 1984). Volunteered computation, on-line gaming and P2P sharing imply to open a place to put in relation different people for a positive purpose; develop, help or improve projects. Getting used to share via Internet implies to build a habit of collaboration among strangers.

Virtues that are transmitted are among others independence, autonomy, and freedom. Also it is a way to transmit the idea of civility (Levine, 2007). Distributed networks lack of a centralized authority and work does not follow traditional rhythm imposed from above. What is behind that is a new way to understand our economy as gift economy. It implies to deal with commons again and how people administer and relate among themselves in a shared space as Elinor Ostrom teaches us (Ostrom, 1990 & 2007).

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