

Code as Storytelling

Insights about Free/Open Source Software Development through an Analogy with Alternate Reality Games

Rafael Kenski

*MSc Analysis, Design and Management of Information Systems
Information Systems and Innovation Group
Department of Management
London School of Economics and Political Science*

KEYWORDS

Open Source Software
Alternate Reality Games
Software Development
Brazil

ABSTRACT

It has been proposed that the concepts of joy and fun have a central status to understand motivation in Free/Open Source Software (F/OSS) development projects. This study tries to be a detailed analysis of what this proposition implies and how a massive collaborative project fuelled mainly by enjoyment-based intrinsic motivations can work. The method was creating a careful analogy between F/OSS development and Alternate Reality Games (ARGs) and checking its assumptions in a case study of a Brazilian ARG called Zona Incerta. The paper concludes by confirming that the analogy is appropriate and by stating that F/OSS development projects may be motivated by factors usually strictly associated with gaming, such as immersion and escapism.

Introduction

In 2007, a project manager in the informatics department at a city council in Brazil used to play an Alternate Reality Games (ARG) in his free time. These games propose puzzles or mysteries so complex that no single person can solve them. Over the time, Jack specialized in managing projects in the community. He used the same tools and skills as in his day job, but to solve puzzles or to interpret storylines, with no promise of a reward or a career for the best players. And he did that every night, for hours on end.

Work for free may look strange, but it is also very common in another community: Free/Open Source software (F/OSS) development projects. These programmers dedicate a huge amount of time developing software that will be distributed for free, in activities almost identical to what they do in their paid jobs. This phenomenon has puzzled many scientists during the last decade. These projects require a huge amount of work from contributors, but each one of them has little incentive to participate, since they can get the same benefits as a free rider. A great amount of research over the last decade has helped us understand some of these issues. Regarding the motivations for developers, it was shown that many motivators interact to account for collaboration in F/OSS projects. However, a group of researchers have pointed out the pre-eminence of joy of the activity itself as the main driver of participation in these projects (Lakhani and Wolf 2005; Hemetsberger 2004; Luthiger and Jungwirth 2007).

This paper will try to study some of the implications of considering F/OSS development projects as an activity based on fun. It will try to understand better what is behind this concept, how it relates to institutional settings and to other motivations and its relationship with other activities built around enjoyment-based intrinsic motivations. The method will be to create an analogy between F/OSS development and ARGs. Communities built around gaming such as ARGs are assumed to be about fun, and the output of their interactions is usually neglected. This will help us isolate some motivations in F/OSS development and look at online collaborative activities through a new angle. The next section is a literature review of F/OSS development motivations and on ARGs. The third part formulates the hypothesis, the fourth part presents the results of the case study and the final part discusses the results.

Literature Review

Motivation in F/OSS Projects

Many different psychological theories have been used to study collaboration in F/OSS projects. Most studies have followed the framework provided by Self-Determination Theory (STD) (for a review, see von Krogh et al. 2008), that distinguishes motivators between intrinsic and extrinsic (Deci and Ryan 1985). Even though authors have been trying recently to expand studies to other theoretical frameworks (von Krogh 2008; Benbya and Belbaly 2010; Krishnamurtha 2006), there is still a predominance of the extrinsic/intrinsic framework in F/OSS studies. According to von Krogh (2009), it happens for three reasons. First, SDT is a widely used framework

Corresponding Author
Email Address: rafael.kenski@gmail.com (R. Kenski)

in psychology and economics, backed up by a large literature and empirical studies. Second, once it became a dominant framework, it enabled comparison of results in many studies. And third, by combining paid and unpaid contributions, the characteristics of F/OSS development make it an interesting phenomenon to study complementary intrinsic motives in collective action.

Bellow, I will discuss in more depth the current status of research of intrinsic and extrinsic motivators in F/OSS development.

Extrinsic Motivators

Extrinsic motivators are those where the reward for the activity is outside of the action itself. The main example is money, a motivator that gains importance in F/OSS development as more and more companies start to collaborate in these projects. Studies have shown that a great part of collaborators in F/OSS projects are at least occasionally paid to contribute, and that payment should be considered in these cases as a strong motivator (Lakhani and Wolf's 2005; Hertel et al. 2003; Roberts et al. 2006).

Economic studies of collaboration in F/OSS development projects have proposed other external rewards for collaboration. Lerner and Tirole (2002) believe that collaboration may provide "delayed" incentives such as experience and career signalling. However, Hann et al (2002) found that Apache developer's salaries do not correlate to the amount of contributions, but to the higher rank within the community.

Some other extrinsic motivations can become "internalized" by programmers, becoming part of their ethos and behaviour and leading to self-regulation (Roberts et al. 2006; von Krogh et al. 2009). A first motivator of this type is reputation, which is important not only as a matter of ego-gratification, but also helps defining leaders and guiding the definition of responsibilities within the community (Weber 2005). Other motivator is the "own-use" value: developers programming to adapt products to their needs or to solve personal problems (Raymond 1999). A third example is reciprocity, also referred to as the "gift culture": each individual has a incentive to collaborate under the premise that he will also receive something in return when needed (Lakhani and von Hippel 2003). And fourth, learning. The fact that the source code is open allows programmers to learn the techniques and the creativity used to build it (Ye and Kishida 2003).

Intrinsic Motivators

Motivators are intrinsic when the rewards for the activity are embedded in the very act of performing

it. Psychological studies within the SDT framework say it is fuelled by activities that increase a person's feeling of autonomy and competence (Roberts et al. 2006). Lakhani and Wolf (2005) divide these motivations in two groups: enjoyment-based motivations and obligation/community-based motivations. The former are activities that are done just for the fun of it. It is frequently analysed in terms of Csikszentmihalyi's (1991) concept of "flow", the experience that occurs when a person's skill matches the challenge of a task and receive feedback for his accomplishments. It is a state of optimal experience, characterized by the loss of the sense of time, increased concentration, aligning of emotion, awareness and action, sense of control over the situation and extreme enjoyment. Obligation/community-based intrinsic motivators are related to the way contributors may be socialised to act in a manner consistent with the norms of the group (Lindenberg 2001). In F/OSS development, these norms include the belief that software should be open, rules and ethics of the hacker culture or even Raymond's (1999) lessons about the F/OSS development method (von Krogh et al. 2008).

In a web-based survey administered to 684 developers in 287 F/OSS projects, Lakhani and Wolf (2005) found that enjoyment-based intrinsic motivation was the strongest and most pervasive driver of participation. More than 61% of the respondents stated that their contribution to F/OSS was at least as creative as anything they have ever done, and the sense of creativity was the most important determinant in the number of hours spent coding for free. The findings also highlighted the importance of flow: more than 72% of developers reported losing the track of time frequently or always when programming. The authors believe programmers in F/OSS development projects may be seeking the enjoyment of matching their skills with the difficulty of the challenge, something that may not be possible in their jobs. The findings led the authors to summarize work in F/OSS projects as "a creative exercise" leading to useful output, or a "form of joint production-consumption that provides a positive psychological outlet for the participants as well as useful output" (Lakhani and Wolf 2005).

They are not alone in putting so much emphasis on intrinsic motivations. In a survey with 1486 contributors of F/OSS development projects, Hemetsberger (2004) also found that the pleasure of the activity itself takes a decisive role in the intensity of collaboration. In a third large scale survey, with 1330 open source developers, Luthiger and Jungwirth (2007) found that the joy of programming accounted for between 27% and 32% of developer's engagement. Fun and flow were motivations for all groups of programmers, unpaid or paid (although in the latter it accounted less for engagement in terms of

number of hours working in F/OSS projects). They also revealed that programmers experienced more fun developing F/OSS than working in commercial conditions. They conclude that working for free is absolutely rational if you consider developers want to maximize their fun.

Alternate Reality Games

We are still far from having a consensus on the definition of ARGs. Most attempts tend to be based on examples, and some definitions only relate them to other concepts such as transmedia storytelling (Jenkins 2006) or pervasive games (Montola 2005). I will follow the definition proposed by Stewart (2008). He focuses on five hallmarks that define ARGs, which will be analysed below.

The first hallmark says that designers break a story into many pieces, and spread them through player's "information space". It includes websites, IM, email, social networks, forums, physical places and news sources (Kim et al. 2009). These elements are all interrelated, being linked by references or puzzles. It is up to the players to find them, interpret them and put them together in a meaningful story. Usually these tasks are so complex that no single person can solve them, which forces the collaboration between players.

The second hallmark states that ARGs are not bound by any medium. This characteristic challenges usual assumptions about gaming. Traditionally, play has been defined as an activity with limits: it is a voluntary contractual activity, limited in time and space (McGonigal 2006; Montola 2005). Pervasive games such as ARGs challenge the magic circle by expanding it either spatially (e.g. being played in any public space), temporarily (e.g. merging with events in the everyday life) or socially (e.g. including outsiders in its dynamics or blurring the distinction between designers and players) (Montola 2005).

These expansions are reinforced when we consider the third hallmark in Stewart's (2008) definition: the use of ICT by players. This includes computers and the internet, but also mobiles and other tools of pervasive computing. However, space is not a "passive container" of actions, and forces ICTs to negotiate with many infrastructures and social practices that give it meaning and shape actions (Dourish and Bell 2007). But, for pervasive games, these obstacles are features. The games give new meanings to existing infrastructures, attach stories to them, use them as game elements and allow bystanders or non-players to interfere in the story (Montola and Waern 2006).

And, finally, in ARGs, the story is collectively built by game designers and by the actions of the play-

ers (McGonigal 2006). In every step of the game, designers must embed the content in online and offline environments and suggest courses of action through affordances. However, it is up to the players to ultimately make sense of them and relate them to other tools, spaces and people. The players must also create their own rules for deciding what is valid or not, what is inside or outside the game. The result is the creation of a universe that responds to player's actions and makes them feel part of it.

The research on motivations of ARG players is very scarce. However, we can get some insights on studies about motivations in video gaming. Yee (2007) found ten components that account to motivation in Massively Multiplayer Online (MMO) game players, which he divided in three clusters – achieving goals, socialising and immersion – that vary in importance according to each player. Another research on single and multi-player videogames (Ryan et al. 2006) concluded that motivation to play is related to increased perceptions of autonomy, competence and relatedness and the resulting feeling of "presence" in the gameplay.

Both authors consider the importance of immersion – Yee (2007) as a motivator, Ryan et al. (2006) as an outcome of successful games. It is relevant because immersion is frequently considered a central theme in the literature about ARGs. One of its expressions is the phrase "this is not a game". It summarizes the idea that ARG designers should deny their involvement in the game in order to blend reality with fiction and improve the player's experience, although this is not a strict requirement for an ARG (McGonigal 2006; Szulborwsky 2005). However, the perception of this immersion is much more complex than mere belief in an alternate reality. Few players, if any, believe in the game's reality. According to McGonigal (2006), the immersion in the game's fictional universe requires simultaneous belief (so as to enjoy the immersion) and disbelief (to find pleasure in murders, kidnappings and other elements of the story).

Hypothesis, Research Methodology and Design

The theory that F/OSS development is mostly an enjoyment motivated activity opens many questions, which will be studied through an analogy with Alternate Reality Games. The analogy will be built according to the definitions presented by Juthe (2005). He postulates that it is possible to assign a predicate from A to B if, and only if, the relationship between elements that determine or influence the predicate in A has a counterpart in B. The assumptions about ARGs that sustain the analogy will be tested in a case study of a large scale Brazilian ARG called Zona

Incerta. The two research questions are structured in the following way:

Research Question 1: Can F/OSS software development be explained even with no obvious extrinsic motivator in the form of career or pay?

The requiring condition is that the elements that justify the player's activities in ARGs even with no obvious extrinsic motivators have counterparts with similar relations in the F/OSS development communities.

Research Question 2: Is it possible that motivators in gaming – specially the concept of immersion – play important roles for developers in F/OSS projects

Fun and immersion in F/OSS has been analysed in terms of flow (Luthiger and Jungwirth 2007; Lakhani and Wolf 2005). But, as we have seen, it is a much more complex concept in ARGs: it involves the story, the way the community collectively builds it and also the fun of gaming. In order to create this analogy, a reasonably large set of elements of ARGs must have counterparts in F/OSS communities.

OSS	ARG
Similarities	
Open access to the source code; right to modify and redistribute it (Open Source Initiative)	Rules of the game collectively built by players (McGonigal 2006)
Large community of developers collaborating primarily through the internet (Feller and Fitzgerald 2002)	Large community of players collaborating primarily through the internet (Kim et al. 2009)
Parallel development / debugging (Feller and Fitzgerald 2002)	Distributed problem solving (Kim et al 2009; IGDA 2006)
Independent peer review (Feller and Fitzgerald 2002)	Negotiations between players
Rapid and incremental release cycles (Feller and Fitzgerald 2002)	Rapid prototype and test of experimental solutions (McGonigal 2008)
May be viewed as tools for sense-making (Iannacci 2005)	May be viewed as tools for sense-making (McGonigal 2007)
Reliance on emails, forums, web-based tools and informalisms (Scacchi 2002)	Creation of an "information space" that includes online and offline spaces (Kim et al. 2009)
Built around coding / programming (Roberts et al. 2006)	Built around collectively building and performing a story (McGonigal 2006)
Differences	
Participation may increase career prospects / signaling (Lerner and Tirole 2002)	No clear career related to the activity
Profit from secondary activities (Lerner and Tirole 2002)	Occasional rewards in form of prizes. No profit involved.
Coding skills required	Coding skills optional, but desirable (McGonigal 2006)
Open problems and requirements (Scacchi 2002)	Problems proposed by game designers, but interpreted collectively (Kim et al. 2009)

Table 1: Comparison table between F/OSS development and ARG communities

The first element of the analogy – the story – has a counterpart in F/OSS development: code. It may sound strange, but it is a reasonable pairing considering the way both relate to other elements. Both are at the centre of their communities and are result of the collective work. They are also the measure of successes and failures: participants are successful in F/OSS development if their code works, just like ARG players are successful if they help to interpret the story or push it forward. They are also the way to achieve the final goal: the project vision in F/OSS development or the solution of the game.

The second element is the way the community behaves and interferes with the story. Scacchi (2001) found how programmers in F/OSS development create tight-knit communities that communicate through of a large number of web-based applications. The requirements and responsibilities in the software development are emergent and informal results of these interactions. This is a good counterpart to the rules of the game emerging through ARG player's interactions in many online spaces.

The third element is the motivations and the fun itself, which we've already seen to be central in both ARGs and F/OSS development projects. But Ryan et al (2007) have broken down the intrinsic joy of playing games in terms of autonomy, competence and relatedness. Verifying the extent of these elements in ARGs will be one of the topics of the case study.

Table 1 summarizes some of the similarities and differences presented in the literature about these two topics.

The Zona Incerta Case Study

The Brazilian ARG Zona Incerta lasted for five months in 2007 and was a marketing campaign for a soft drink. It told the story of a dispute between a Miro, a biologist, and Arkhos, a multinational biotechnology company who wanted to turn the Amazon rainforest into an internationally controlled territory. The participants interacted with characters and story elements through several media, such as blogs, online videos, mobile phone messages, hidden objects, stencils and live events. The blurring between the real and the fictional life was also strengthened by unforeseen events, such as an ill-advised plenary speech by the leader of the opposition party in the Brazilian Senate against Arkhos Biotech, widely reported by the Brazilian media (G1 2007). According to the organizers, the game had 400,000 participants. However, the number of hardcore players – those who interacted with characters and solved the challenges proposed by the game designers – is way smaller. The case study was done through semi-structured interviews with 10 of these most active

players, done through Instant Messaging (IM) services.

Findings

The case study resulted in some insights about the elements required in the analogy. We will present them here in three groups: extrinsic motivations, intrinsic motivations and the configuration of the work itself.

Extrinsic Motivations

The Zona Incerta ARG didn't have any productive outcome that lasted once it was over, and most of the discussions and players activities have since been deleted. However, many participants mentioned getting extrinsic rewards for playing. The first one is learning, such as acquiring management and problem solving skills and knowledge in a topics related to the puzzles. The second is friendships and social contacts. The third, surprisingly, is career benefits: one player mentioned the game as a source of business networking and another, as a good story to tell in job interviews.

Important as they may be, these extrinsic rewards were more a post hoc evaluation of the benefits than a determinant of hours spent in the project. However, they are frequently mentioned as reasons for still being engaged in the genre (for many, Zona Incerta was the first ARG they've played). In subsequent ARGs, these extrinsic rewards may play a stronger component as motivators.

The analogy is strengthened by the comparison of the way work is performed in both communities. First, most players reported that their ARG activities were very similar to what they do in their day jobs. Second, they reported the existence of a core group responsible for a great part of decision-making, similar to hierarchies that emerge in F/OSS projects. Other secondary groups were also formed, which occasionally generated conflicts – similar to parallel versions of software (or "forking") in F/OSS development. The main group gathered most of the information about the game, evaluated contributions of players and assigned tasks to some of them. Reputation also played an important role: the more commitment you showed, the more decision-making authority you receive, which mirrors Weber's (2005) analysis of coordination problems in F/OSS projects.

Intrinsic Motivations

Many intrinsic motivations were mentioned during the research:

Psychological benefits: Some credit the game for giv-

ing them thirst for knowledge or making them overcome shyness, lack of self-confidence, depression or phobias. However, the most mentioned motivator for playing was the joy of solving puzzles and following the story.

Autonomy, competence and relatedness: The main motivators in videogaming according to Ryan et al (2007) were also present in the player's statements. Autonomy was a strong motivator. Players said that they were able to "specialize" in activities where they had more skills or to try new things, because "the limits were different from the real life" and it was done voluntarily. The concept of competence was also present: being able to solve problems, accomplish tasks and influence the story was mentioned by all interviewees as motivators. And, finally, the social bonds and the identification with the community are also mentioned as strong factors driving participation, which confirms relatedness as a motivator.

Immersion: The perception of immersion was as strong a motivator. The ARG participants were well aware that it was only a fabricated reality, but they made an effort to perform it. One of them said "it was even more real than what I see in news programs, because I could influence the events." The live events were also frequently mentioned as something that increased the feeling of immersion, but the same did not apply to the appearance of the story in newspapers, suggesting the feeling may work only in a situated way. There is also a strong subcomponent of escapism: players reported frequently longing to "switch to the alternate reality" or losing track of time while playing.

Discussion

Our answer to the first research question is that it is possible to assume that F/OSS could exist even in the absence of extrinsic motivators in the form of career prospects or pay – enjoyment-based motivations account for most of collaboration. However, controlling for these factors turned out to be more difficult than imagined at first. The emergent results of participant's activities and interactions influence their education, networking and life experiences, which may bring extrinsic rewards. In F/OSS development, this may help us understand Hann et al (2002) finding that salaries from Apache developers correlate with rank, but not with participation itself: some of the extrinsic benefits from collaboration emerge from the experience as a whole, and not only from developing more lines of code.

Regarding the second research question, we can conclude that gaming elements – and particularly immersion – also might play a role as motivations for F/OSS development. Optimizing for fun (as proposed

by Luthiger and Jungwirth 2007) means not only providing optimal challenges for developers and a clear and understandable project vision (to generate "flow") but also taking immersion into account and considering the way the programmers may influence the outcome (even if through collective negotiations) and the feelings of autonomy and relatedness. Some of these elements are already being taken into account in F/OSS development practices. For instance, prototyping and short release cycles are ways in which programmers may exercise their autonomy and creativity by testing (and even possibly discarding) new ideas.

The research also showed that one side of the immersion in ARGs is in the concept of escapism, which may also play a role in F/OSS development. Just like stories in ARGs create a reality with a clear and engaging meaning, Lerner and Tirole's (2002) notion of career signalling implies that collaboration in F/OSS reduces the complexities of social and technical skills and aptitudes to a proxy: code. For those with enough programming skills, it might be tempting to "escape" to a universe where the rules favour their aptitudes.

One of the most important conclusions is the importance of building communities, services of infrastructures based on fun. Enjoyment-based motivations have been shown to be the most important driver for collaboration in Wikipedia (Nov 2007) and the second most prevalent motivator for customizing and inventing new products for personal use in the United Kingdom (Von Hippel et al. 2010). It is possible that many of the psychological, political and social elements that emerge in ARGs and F/OSS development communities also play an important role in a wide range of communities that are based on intrinsic motivations. Some examples includes the concepts of "commons-based peer production" (Benkler 2006), "cognitive surplus" (Shirky 2010), Wikinomics (Tappscott and Williams 2006) and crowdsourcing (Howe 2008).

This research has some limitations. First, the case study was focused on the most active participants of the ARG. A more comprehensive analysis of the players could yield other kinds of insights and even different analogies. And second, the results of this research could be perfectly assigned only for a subset of all contributors in F/OSS development projects and the analogy would not be work less for programmers that are paid to develop F/OSS, for instance, are known to rely less on enjoyment-based intrinsic motivation.

The findings also suggest some topics for future research. It is important to verify these findings with empirical research in F/OSS communities. We also

need a more comprehensive theory of the foundations of the concept of fun in collaborative and pervasive projects, its foundations and its dynamics with extrinsic motivators (“Is the fun really gone when you pay people to collaborate?”). This way, we can not only have a better understanding of what is behind F/OSS development and other online productive communities, but also create new infrastructures able to maximize the potential of these groups.

References

- Benkler, Y. (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, London: Yale University Press.
- Benbya, H. and Belbaly, N. (2010) Understanding Developers’ Motives in Open Source Projects: A Multi-Theoretical Framework. *Communications of the AIS*. Forthcoming.
- Csikszentmihalyi, M. (1991) *Flow: The Psychology of Optimal Experience*. New York, NY: Harper Perennial.
- Deci, E. and Ryan, R. (1985) *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY: Plenum Press.
- Dourish, P. and Bell, G. (2007) The Infrastructure of Experience and the Experience of Infrastructure: Meaning and Structure in Everyday Encounters with Space. *Planning and Design* 34(3). pp. 414-430.
- G1 (2007) Em plenário, senador critica empresa fictícia. <http://g1.globo.com/Noticias/Politica/0,,MUL16083-5601-6017,00.html>. (accessed 22 August 2010).
- Hemetsberger, A (2004) When Consumers Produce on the Internet: The Relationship between Cognitive-affective, Socially-based, and Behavioral Involvement of Prosumers. <http://opensource.mit.edu/papers/hemetsberger1.pdf>, Working paper.
- Howe, J. (2008) *Crowdsourcing: How the Power of the Crowd is Driving the Future of Business*. New York, NY: Crown Business.
- IGDA ARG SIG (2006) Alternate Reality Games. <http://igda.org/arg/resources/IGDA-AlternateRealityGames-Whitepaper-2006.pdf>. Whitepaper. (accessed 27 August 2010).
- Juthe, A. (2005) Argument by analogy. *Argumentation* 19(1). pp. 1-27.
- Kim, J., Lee, E., Thomas, T. and Dombrowski, C. (2009) Storytelling in new media: The case of alternate reality games, 2001–2009. *First Monday* 14(6). <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/2484/2199>.
- Krishnamurthy, S. (2006) On the intrinsic and extrinsic motivation of free/libre/open source (floss) developers. *Knowledge, Technology & Policy*. 18(4). pp. 17-39.
- Lakhani, K. R. and Wolf, R. (2005) Why Hackers Do What They Do: Understanding Motivation and Effort in Free/Open Source Software Projects. In Feller, J., Fitzgerald, B., Hissam, S. and Lakhani, K. (Eds.) *Perspectives on Free and Open Source Software* (pp. 3-22). Cambridge, MA: MIT Press.
- Lerner, J. and Tirole, J. (2002) Some simple economics of open source. *The Journal of Industrial Economics* 50(2). pp. 197-234.
- Lindenberg, S. (2001) Intrinsic motivation in a new light. *Kyklos* 54(2-3). pp. 317-342.
- Luthiger, B. and Jungwirth, C. (2007) Pervasive Fun. *First Monday* 12(1). <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1422/1340>.
- Mcgonigal, J. (2006) This Might Be a Game: Ubiquitous Play and Performance at the Turn of the Twenty-First Century. Ph.D. Thesis, University of California, Berkeley.
- McGonigal, J. (2007) Why I Love Bees: A Case Study in Collective Intelligence Gaming. http://www.avantgame.com/McGonigal_WhyILoveBees_Feb2007.pdf. White paper. (accessed 22 August 2010)
- McGonigal, J (2008) Making alternate reality the new business reality. *Harvard Business Review* 86(2). p. 29.
- Montola, M. (2005) Exploring the edge of the magic circle: Defining pervasive games. Proceedings of DAC. IT University of Copenhagen, Denmark.
- Montola, M. and Waern, A. (2006) Participant roles in socially expanded games. PerGames workshop of Pervasive Conference. University College Dublin, Ireland.
- Nov, O (2007) What motivates wikipedians? *Communications of the ACM* 50(11). pp. 60-64.
- Open Source Initiative (2010) The Open Source Definition. <http://www.opensource.org/docs/osd>. (accessed 23 August 2010).
- Raymond, E. (1999) The cathedral and the bazaar. *Knowledge, Technology & Policy* 12(3). pp. 23-49.
- Roberts, J.; Hann, I.-H. and Slaughter, S. (2006) Understanding the motivations, participation and performance of open source software developers: A longitudinal study of the apache projects. Marshall School of Business Working Paper No. IOM 01-06.
- Scacchi, W. (2002) Understanding the requirements for developing open source software systems. *Software, IEE Proceedings* 149(1). pp. 24-39.
- Shirky, C. (2010) *Cognitive Surplus: Creativity and Generosity in a Connected Age*. London: Penguin Press.
- Stewart, S (2008) Alternate Reality Games, <http://www.seanstewart.org/interactive/args>. (accessed 23 August 2010).
- Szulborski, D. (2005) *This Is Not a Game: A Guide to Alternate Reality Gaming*. Raleigh, NC: Lulu Press.
- Tapscott, D. and Williams, A. D. (2006) *Wikinomics: How Mass Collaboration Changes Everything*. New York: Portfolio.
- von Krogh, G., Spaeth, S., Haefliger, S. and Wallin, M. (2008) Open source software: What we know (and do not know) about motives to contribute. DIME working papers on intellectual property rights. http://www.dime-eu.org/files/active/0/WP38_vonKroghSpaethHaefligerWallin_IPROSS.pdf. (accessed 27 August 2010).
- von Hippel, E. and von Krogh, G. (2006) Free revealing and the private-collective model for innovation incentives. *R&D Management* 36(3). pp. 295-306.
- von Hippel, E., de Jong, J. and Flowers, S. (2010) Comparing business and household sector innovation in consumer products: Findings from a representative study in the UK. <http://ssrn.com/abstract=1683503>.
- Weber, S. (2005) The political economy of open source and why it matters. In Latham, R. and Sassen, S. (Eds.) *Digital Formations* (pp. 178-211). Princeton: Princeton University Press.
- Ye, Y. and Kishida, K. (2003) Toward an understanding of the motivation of open source software developers. *25th International Conference on Software Engineering*. Portland, Oregon.
- Yee, Nick (2007) Motivations of Play in Online Games. *Journal of CyberPsychology and Behavior* 9. pp. 772-775.