Community-Based Innovation among Elite Orienteers

Full Paper

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ABSTRACT

We have studied a form of *community innovation* within the sport of orienteering, which in the Nordic countries consist of a closely knit group with a strong sense of community. This study shows how the processes for developing new technologies are driven by a strong sense of idealism, with little or no commercial motivation. Thus, this represents a kind of community development and sharing with a number of unique characteristics. While the community is central to participants' endeavours of developing their systems, the participants are not representative of the typical member. On the contrary, they are examples of a minority that put in significant efforts of contributing to the larger group. What we argue is unique about the case we have presented is that the technology development starts out from a few number of highly motivated individuals that through limited collaboration with others builds technologies that get extensive proliferation and use within the community.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics • **Networks** → Network reliability

KEYWORDS

Community innovation; orienteering; user creativity; sports technology.

1 INTRODUCTION

Currently, we see a number of user-driven communities/cultures for creative technology design and development. Many of these have a strong on-line presence where interaction and sharing between members plays a central role. Examples include maker cultures [16], DIY-communities [15], and the open-source movement. A characteristic of these is a strong focus on creative work and collaboration, and how sharing between members makes it possible to learn from each other in the creation of new technologies, thereby allowing others to become makers, develop their own DIY-projects, or increase the amount of available open source code.

Figure 1: Orienteering map and example orienteering terrain.

This paper is concerned with *community innovation*, which we define as when members of a community design technologies and solutions for the benefit of the whole community, and share this in a non-profit manner. We have studied community innovation within the sport of orienteering, which in the Nordic countries is performed by a closely knit group with a strong sense of community. The sport has a long tradition of building its own customized technologies and sharing these at no or very low cost. Our study shows how the processes for developing new technologies are driven by a sense of idealism and little or no commercial motivation. The development of the technologies was primarily initiated for the purpose of improving the participants' personal skills of orienteering, as well as letting other orienteers

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improve their performance through the technologies. This differs from many other user-driven communities in which sharing often occurs to the improvement of shared skills of building and creating [14], while in orienteering sharing occurs for the purpose of improving the orienteering skills of the athletes and the development of the sport. In orienteering there is a small group of people from the community that are building the technologies that they share with the larger group. Thus, this represents a kind of community development and sharing with a number of unique characteristics that differs from what previous research have shown [7], for instance in the DIY and open-source movements [5]. Here we explore these characteristics, particularly focusing on the processes for how the technologies are practically developed, and the underlying motivations and driving forces of the developers.

What is unique about this kind of community innovation is the predominant focus on the skills of orienteering of the individuals, and for the larger community. This particular focus on the activities of orienteering shapes the way these technologies are developed within the community. The study lead us to revisit three underlying drivers of community development a) the relation between the individual and the community, b) the role of social recognition and reputation, and c) other motivational drivers, and the particular ways these were shaped through the particular focus on orienteering rather than putting technology development as such at the core.

2 ORIENTEERING

Orienteering is an outdoor navigation sport popular in the Nordic countries with about 200 000 active members. Athletes use map and compass to find checkpoints along a mapped course in the terrain. In the 1900s it was first practiced as a military exercise and has since then developed into a highly competitive sport requiring athletes to be able to run at high speed in demanding terrain while simultaneously making cognitively demanding route choices based on readings from map and compass [1], see Fig. 1. The combination of physical and mental skills makes it especially challenging and inspiring to design for. Orienteering has a long track record of using forefront technology to improve athletes' skills [17] as well as developing new experiences for spectators of the sport. The typical practice of elite orienteers consist of running and other forms of endurance training with and without elements of map reading. Specific map reading practice sessions are also conducted focusing on various techniques for efficiently reading the terrain, keeping track of one's position, connecting terrain and map, and most importantly to make the most efficient route choices. This is conducted in combination with various forms of running exercises in order to practice map skills at various levels of exertion. An important aspect is also post-analysis of map reading and route choices during practice and races. This is often conducted using GPS-data, but surprisingly often straight from the athletes memory.

While being a popular sport in the Nordic countries, there is limited commercial interest from large sport technology companies. Compared to sports of worldwide interest such as football or running, orienteering generates limited resources for development of novel commercial technologies. Moreover, in orienteering, participants of all kinds, young and old, recreational as well as elite, practice and compete in the same arena: local forest areas and parks. Competitions have a wide range of classes of varying difficulty and length. This makes it easy for everyone to participate at their own level and for newcomers to try the sport out at an entry level. This together with the Nordic non-profit form of organizing sporting clubs are two of the reasons for the prominent sense of community within the sport. Substantial amount of non-profit work is involved in organizing events and activities and has contributed to a tradition of self-developed technologies within the sport. Moreover, this has made the community used to trying out and spreading "internal hacks" and not requiring a thorough commercial finish.

We have studied and collaborated with the community of orienteers in a series of projects. In addition to the work presented here, we have investigated their use of technology in exercise [17], and designed and explored technology in collaboration with local clubs [12].

3 RELATED WORK

HCI and related areas have for a long time engaged in understanding technology development among various kinds of non-professional groups, most recently maker spaces [16], hacker communities [10], and DIY groups [15]. For these groups, technology development is the core their activities and the kind of community building and sharing of knowledge that happens in these groups primarily evolve around the aspects of the technology, and serve the purpose of improvement and learning of technology oriented skills. Recently, the relations and influences of these maker groups to commercial and professional forms of innovations have been discussed [9]. Contrary to this, the community that we have studied is focused on performing the sport of orienteering and the engagement of our participants is primarily about contributing to their own and others performance of the sport. While the results of this paper concern non-profit developers we would like to position this kind of engagement as a form of community-based innovation that influences and has contributed to a commercialisation and innovation in an area of sports that would not have happened otherwise.

3.1 Making and DYI

This type of community innovation is related to several other kinds of community based technology development. In studies of maker activities the instrumental purposes have often been foregrounded through aspects such as learning, innovation and community building. HCI has previously explored maker culture and the activities of making. Often, the emancipatory and democratizing potential of making and maker culture is brought to the fore, as a way of rethinking educational approaches, develop new ways of innovation, and develop novel creative approaches to design. In a similar fashion, Do-It-Yourself (DYI) communities spans domains as different as knitting, repurposing of IKEA furniture [13], and electronics. These communities are commonly brought together by the willingness to explore materials, build and create personal things, and share that with other like-minded DYIers. These

movements has been referred to as "expert amateurs" [4, 7] to acknowledge the skills and expertise that exist and is developing among engaged and motivated amateurs that share their exploits so that others can build on it, and learn from it. Kuznetsov & Paulos have shown that the predominant motivations in many DIY communities are open sharing, learning, and creativity, rather than building social capital or commercial gain [7].

3.2 Open Source Coding and Participatory Content Creation

Open Source is by now a well-established way of developing systems, both for commercial and non-commercial purposes. While it started as an alternative to large corporations, its tools and methods for collaboratively writing code and developing complex systems have shown many benefits and become a common way of working also in the commercial sector. Many of the coders participating in open source projects are motivated by their need of the product that is developed [8], but several also contribute with the purpose of building a professional network and improving their programming skills [5], or wanting to give back to the community [8]. Or simply because they like the challenge [8]. Since many businesses now are using open source code in various ways in their products, it has become quite common that programmers participate in open source projects on paid work time [5, 8]. This development of the open-source movement shows how hobbyist practices may spill over on commercial forms of technology development.

Yet another area related to community development is collaborative content creation such as Wikipedia and various rating and review systems. In such communities, the users provide the content of systems for others to use or consume. These communities are similar to DIY communities in that users provide their own experience and expertise to allow others to become informed, make decisions, and learn. They are similar to open source in that they collaboratively build something, such as the vast knowledge-base in Wikipedia, adding to and using each other's contributions. However, their motivations have been shown to differ from open source coders, for example in professional motivation. It seems to be more difficult to build a professional reputation as a Wikipedian, compared to build a reputation as a skilled programmer by participating in open source projects. Thus, few Wikipedians cite career reasons for contributing to Wikipedia [11]. Rather the fun of participating, and the ideological motivation of free sharing of knowledge was cited as motivations for contributing [11].

Our community of study, orienteering, and the individuals that develop systems for orienteers have a slightly different focus than for example makers and DYIers in that their focus is on the activity of orienteering and not on the activity of creating systems. There is also a difference in target users. For makers, DYI, Wikipedia, and open source, the receivers of the output are fairly undefined as a group. Our community innovators have a perfectly clear picture of who their target users are, and how their systems will be used. This led us to further investigate their motivations, method of development, and mechanisms for spreading their systems.

4 STUDY SETUP

Potentials interviewees, i.e. orienteers that have built systems for orienteering that has been widely used, were identified in collaboration with the head of technical development at Swedish Federation of Orienteering (SOFT), himself also an orienteer in the Swedish national team at the time.

Six identified candidates were approached with a short email survey containing questions about functionality of their systems, the development process, and how they worked with marketing the systems. All six candidates replied to the survey. Survey responses served as input for the preparation of the interviewees.

All six respondents were asked if they wanted to be interviewed. Four of them accepted. Three of the interviews were made over Skype due to geographical distance, one was made in person. All interviews were recorded and transcribed, and then analysed through open coding to identify prominent themes and issues.

5 PARTICIPANTS

The participants in our study have built a variety of software tools for orienteering practice and competition. All these have been widely used in the community during different periods in time. Some are still in use while others have been replaced by newer technologies. This collection of tools and how they have been used over time provides a way to understand aspects of how technology is developed within the community of orienteering, how the technology supports the sport to evolve, and contributes to a more general understanding of technology development in non-profit communities. The different lifespan of the technologies that the participants have developed, their uptake in the community, their contribution to the technical standards of orienteering as well as the degree to which these generate commercial gains for the developers, highlights a number of novel aspects about the forms community based innovation may take, as well as about the participants themselves.

5.1 Participant 1

Participant 1 has created two systems that have become widely used in the community of orienteering, *Winsplit* - a system for electronic time keeping that provides split times between checkpoints for each competitor [19], and *QuickRoute* – a system for analyzing and comparing route choices by dynamically displaying GPS tracks on a map [18]. He started to work on the system that finally became Winsplit as a teenager, and continued working on it throughout the university. He has since acquired a Master's degree in computer science and has been working as an IT consultant for more than ten years.

Winsplit started out as an individual system for orienteers to analyse their own split times. It was later bought by the Swedish Federation of Orienteering (SOFT) and has since become a standard system for timekeeping and has been widely used in the international orienteering community. QuickRoute is available as an open source software for download, and had more than 2000 installations at the time of the interviews.

5.2 Participant 2

Participant 2 created Runoway – a system that supported athletes in analyzing route choices and split times after races. The first version of the system was released before GPS watches were commonly used and allowed athletes to input their route choices by hand. Later versions had functionality for importing GPS tracks from watches, and also to "replay" tracks from several athletes simultaneously to compare the speed of various route choices. The system was used for several years and a database of approximately 1500 competitions were collected, with more than 100.000 individual runs. Swedish Federation of Orienteering sponsored the maintenance of the system until it was bought by a company that wanted to push it further as product. However, it never took off commercially. The system development started out as a university project that lived on, and was turned into part time work when SOFT sponsored its maintenance. Since he started developing the system, he has acquired a Master's degree in computer science and has been working as a computer professional for more than ten years.

5.3 Participant 3

Participant 3 developed his system Opath [3] when Runoway had been bought and fallen out of use without any replacement. He felt that there was a need for a new and modernized system for analysis and follow-up and thus started to build Opath. The system imports GPS tracks for analysis and allows athletes to play several tracks simultaneous for comparison. The system also provides various forms of statistics. Opath started out as a private project to support participant 3 in his own efforts to become an internationally competitive orienteer, but the key functionality of the system is based on comparison with other athletes, which made it natural to invite other athletes, clubs, and competition organizers to use the system.

He has now a Master's degree in Computer Software Engineering and is currently working as a software developer.

5.4 Participant 4

Participant 4 has a long and solid track record of developing systems for orienteering to develop and promote the sport. It started with World of Orienteering, a web site that he started already 1995. The site, www.worldofo.com, is still one of the main sites collecting news about orienteering, maintaining a competition calendar, a map data base and other material relevant for people interested in orienteering. Traffic lies around 5000 hits per day and 100.000 hits per month at the time of the interview. Later on he has developed 3DRerun [6], a software for analyzing GPS tracks that according to many in the orienteering community is the most advanced tool available. For example, it is used by many athletes in the Swedish national team [17]. He has also worked with television broadcasting, developing software that supports live showing of GPS tracks for competing athletes (see fig. 2), and holding workshops with broadcasting companies to promote and refine the software. He is not formally educated in computer science and have thus had to learn a lot on the way while developing his systems.

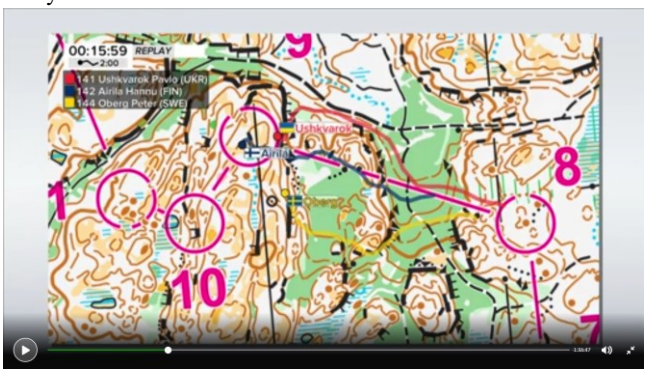

Figure 2: Screen shot from the television broadcast of the 2016 world championships of orienteering. Footage from the woods are intersected with live images of GPS positions for several athletes to allow comparison. The work of Participant 4 laid the ground.

6 RESULTS

6.1 Creators and the Larger Community

The first aspect that we would like to bring up from our interviews regards the relationship between the creators and the community in which they are members. All four had strong positions within the sport of orienteering with merits at national and international levels. They were thus quite known and respected in the orienteering community. This had laid ground for personal relationships to central functions in the sport such as national teams and coaches, training centres and organizers of large events and competitions. Their knowledge and experience of orienteering both and as a sport, and the community in which it lives, were important sources for them in identifying the needs and requirements for the technologies that they later developed. In particular, these needs primarily originated from personal efforts and goals in improving themselves as athletes. In our interviews, they repeatedly talked about how their initial inspirations for developing a new piece of technology came from their personal goals of becoming better orienteers. For instance:

Participant 3: "*I wanted to build a digital training log adapted for orienteering with monitoring of details of orienteering technique. I wanted to improve my orienteering and my ambitions as an elite athlete.*"

However, the motivations and engagements of our participants were not limited to their personal goals as athletes. A related source of motivation was to contribute to the development of the sport, by inviting others to use the systems for improving their skills. They invested substantial efforts in making their technologies available for the whole community. In some cases (such as OPath), the systems they developed even depended upon comparison with other users, and the more users the more interesting and richer the system would become. Thus the more users the more benefit for themselves as orienteers. For this purpose, the central position that

our participants had in the community of orienteering has contributed to get feedback from various user groups and to reach a critical amount of users.

Participant 4: "*It is important that the system gets used, that the best runners use it and improve, and that the people around me gets to use it."*

The participants also brought up the benefits of contributing to their community on a larger scale. The reasons for this included improving the organisation of races, the improvement of the quality of training, socializing around various aspects of orienteering, and to make the sport more visible to the general public.

Participant 4: "*My stuff has meant something for the sport of orienteering. The aggregation of information has led to several blogs, and I have influenced politically with my stuff and pushed the development"*

An example of how these systems have contributed to the visibility of orienteering is seen in how international orienteering championships are now broadcasted in real-time television using technologies portraying athletes in the terrain juxtaposed with a map with overlaid GPS markers making it possible to compare competitors. The technologies that some of our participants developed were a predecessor to this.

6.2 Individualistic Purposes

In addition to being central within the community of orienteering the participants of our study all had a strong technical interest and the basic knowledge required getting the process of developing their systems started on their own.

Participant 1: "*Had I not had the technical skills that was required from the beginning I would perhaps have seen the possibility but it would never have come something out of it."*

The combination of deep skills in orienteering and sufficient technical knowledge allowed them to identify possibilities for improving aspects of the sport based on the technical opportunities for realising these. For instance, the system Winsplit was built when the technical progress was at a point when a system for electronic time keeping and control punching at checkpoints was getting used.

Participant 1: "*I got a Casio watch that stored splits when I was 13, it was 1991, and I wanted to calculate split times between the check points. So I wrote a program in Basic that was the embryo for WinSplit. Then when electronic time keeping became commonly used I started building the Winsplit-system.*"

The combination of personal interest and appropriate skills was a motivator for them to try out and build systems on their own. However, none of them did any real market analysis or requirements analysis beyond their immediate knowledge from the sport. The process of creating the system in itself was an important driver, and as discussed above, in doing this, they started first and foremost from the personal needs and goals with respect to orienteering.

Participant 1: *I wanted to solve problems on my own and I like to work alone. Not so interested in opinions from others*

None of the participants described that they explicitly probed other people for what kind of functionality they wanted or needed. Instead, they all seemed to believe that if they managed to build a system that they themselves wanted, others would also be interested in using it.

Participant: 2 "*We did not check out what was actually available. I know there was some similar stuff, but we never looked, we just built what we wanted."*

A personal driver for building such systems that was described by several of our participants was the actual enjoyment of developing a working system for a sport that they put so much personal investment in.

Participant 3: "*It was a fun problem, otherwise, I would never had done it."*

The mere challenge of taking on a technical problem was an important inspiration in developing the systems during their spare time, basically without any compensation. Furthermore, the participants started building these systems when they were students and at the beginning of their work life (most elite orienteers are required to have a regular job).

Thus the motives for building these systems largely came from the ambition to improve oneself, orienteering as well as engineering wise as well as contribute to develop the sport.

When asked about their choice of working alone, the participants talked about the difficulties to find collaborating partners with the same interests, availability, and motivation. It was not easy for them to find partners that wanted to put in the effort needed when there were small chances of earning money in the end.

Participant 4: "*I would have enjoyed having someone that was dedicated but not in it for the money, but I haven't found anyone."*

They appreciated the freedom of working alone but were at the same time aware of the benefits that come from collaboration, for instance in terms of quality.

Participant 3: "*Would have liked to include a friend, but he was busy. You write better code if you are two people."*

The choice of working alone thus seemed to stem from a combination of practical reasons and personality traits. Participants preferred to complete this type of projects alone even though they saw the benefits that would have been given by increased collaboration.

Participant 1: "*I have always worked alone. It gives a lot of freedom but is also lonely*."

An important secondary output of the work with developing systems has been professional for participants 1-3. They all report that they have learned skills, built experience, and created networks that they have used for example to apply for jobs.

Participant 3: "*This work is very good when I apply for jobs."*

The variety of efforts that were required in developing and deploying the systems described has given them skills and

experience they could not acquire from university education. They have had to deal with challenges of scaling up, building a critical mass of users, handle customer support and distribution of software, just to give a few examples.

Participant 1: "*I have learned more from my projects that from formal education. Deep practical experience is almost always more important. I have a broad competence, from optimization to accounting."*

6.3 Supporting Structures

Even though individual skills, motivation and their reputation in the community were important factors in these processes, external supporting structures have played an important role in the realisation of these systems. These structures were sometimes formal at local and national levels, such as the Swedish Federation of Orienteering or local orienteering clubs. They were also informal such as the volunteer organisation around a competition, or friends in a training group or team.

The purpose of SOFT is to promote and support the sport of orienteering and in some cases they choose to invest personnel or money in technologies that are relevant for the sport. However, they do not act as venture capitalists that invest in ideas with great commercial potential, but prefer to wait until a system has proven valuable for a broad range of their association's members before they give any financial support. When Winsplit and Runoway respectively were mature enough, well tested, and had a fairly large user base that proved the value of the systems, SOFT bought or sponsored further development, maintenance, and hosting. This allowed the developers to further improve the systems. The fact that the national federation supported the system and their developers also provided legitimacy to attract new users. The possibility of using the official communication channels of SOFT for information and marketing also contributed to a wider use of the systems. In the case of Winsplit it later even became the official time keeping system provided by the association.

Particpant 1*: "I hadn't been able to finalize this without the back up of the orienteering federation. Neither would I have been able to reach the level of distribution that I did [for WinSplit]."*

During the phases of designing and developing the systems, the informal structures played an important role. As discussed above, the participants were all central in the community of orienteering, and they had successfully used their personal network to spread their systems. However, to thoroughly test and validate the systems, and to reach a critical mass of users, additional resources and support were necessary. The initial way of achieve this in the early stages, e.g. to try new system functionality, they often piggybacked on competitions as it gave access to large groups users at the same place at the same time.

Participant 3*: "I send out email to race organizers and the interest and potential willingness to try out a system largely depends on the person receiving the email. Sometimes I help out so that they get going. I try to get people that organize races to use the systems in training in order to increase the overall usage."*

Local orienteering clubs played a central role for those of the systems that relied on social features such as comparison between runners. Our participants noted that usage of their systems grew in clusters and those clusters often emerges in the different clubs, that later formed into larger user groups.

Particpant 3*: "It is important to reach critical mass. That's why it works better in clusters, everyone likes it better when people around them also uses it. So if a few in a club starts, then others follow."*

For one of its official launches, Winsplit drew benefits from the race structure of one of the largest orienteering competitions in the world, O-ringen (www.oringen.se),that gathers more than 16000 orienteers yearly. The organizers of the race asked if they could use it as their official timekeeping system.

Participant 1*: "I was contacted by O-ringen, which was good timing. My shift of technology coincided with when the shift to electronic time keeping were happening widely."*

The surrounding formal and informal structures from clubs, race organisers and SOFT thus played a central role in various steps in the process. They provided possibilities for improving the procedures of testing and evaluation, allowed reach out to various user groups for various purposes throughout the process, and provided legitimacy and visibility to the systems. While the financial back up from clubs and the national federation were limited, the chance of being seen at events and races were important to the overall process of continuing working on the systems.
From such episodes it was also made quite clear that there had been substantial effort put into the development of the systems and that the path to widely used products was not easy and straightforward.

6.4 The Role of Social Recognition

As mentioned above, the participants of the study were established names in the broader community of orienteering, primarily through their participation and results in orienteering races at national and international levels. The development of their systems contributed further to them being known around the community of orienteering. However, building social recognition and reputation was not brought up as one of the reasons for engaging in the development their systems. Quite the contrary, all of them claimed they had been keeping a low profile in connection to their respective system, not advertising their names as developers or owners.

Participant 1: "*Most people never see my name. I get some direct feedback but it really doesn't matter that most people don't recognize that I was the one building the systems."*

However, this did not mean that they did not appreciate attention and recognition for their work. They all appreciated all kinds of user feedback, both positive and negative, and even though the systems provided digital channels such as email for that type of communication, personal interaction was highly valued. Even though the primary personal drivers came from the combination of their deep engagement in the sport and their interest in systems development, social recognition could still provide additional boosts of motivation to refine and extend their systems.

Participant 2: "*I have received a lot of positive comments, it is a strong driver that people like what you do."*

Some of them claimed that the most valuable and possibly most honest user feedback came in public situations e.g. at competitions, when people used or talked about a system without knowing that its developer was present.

Participant 2: "*Fairly few know that I made the system, but it is fun to hear comments about the system. Sometimes I hear people make comments in line for the toilets or so. But I keep a very low profile at such occasions."*

We are not claiming say that our participants were particularly modest and ignored any attention or social recognition. They all said they had got a kick out of being recognized as the person behind their system, even though it clearly was not their primary motivations.

Participant 1*: "Last year I travelled and ended up at a competition in San Francisco and became 'the winsplit guy', that made it worth everything."*

6.5 Commercialization

Although the systems that our participants created were used by a large part of the orienteering community, there were very small financial gains generated around these systems. They all stated that commercialization and making money were not high up on their list of priorities when they started developing the systems or throughout the process. They found their primary motivation and satisfaction in the process of building the systems and contributing to their sport.

Participant 3: "*Orienteering needs some stuff to be for free."*

Consequently, they had spent very little on advertising beyond recruiting users, neither had they worked out a business model. They were willing to put in significant amount of time to become better orienteers, and almost equal amounts to build a system, host it and to solve technical problems. Based on their reasoning, it seems like the motives behind their a low interest in commercialization was that they prioritized making their systems available to orienteers as means of contributing to developing orienteering as a sport and for others to improve as athletes. They were not interested in commercialization at the expense of achieving a broad use in the community. They preferred providing opportunities for a wide range of orienteers to improve their skills.

Participant 4: "*To me, commercialization must lead to development (of the sport) and improvement for the users. I wouldn't want to be selling the system if it would mean that less people got access to the system."*

In some cases the choice of not commercializing but releasing the system as open source software was based on the level of customer support that they thought could be provided. If participants did not have the means or the time for what they believed was adequate customer support and system updates, they preferred not to sell the system but to allow people to use it "as it is". Not going fully commercial also allowed space for compromises in terms of compatibility with related systems and devices, adherence to standards, robustness etc.

Participant 1: *If you start selling the system off the shelf, then you are getting increased responsibility for support and maintenance. As it is now, people get go use the system at their own risk. QuickRoute has about 1500-2000 installations, in order to support that you need to start charging money for the system.*

All of the participants were also aware of the limitations of the orienteering community as a possible customer base. They kept coming back to the fact that orienteering is a small sport internationally, and compared to football or running it is even small in the countries where it is popular (Sweden, Norway, Finland, Switzerland).

Participant 2: *I had some thoughts about going commercial, but I came to the conclusion that it would be very difficult to live out of it. Just to make it work financially, you need a larger target group than merely orienteering can provide.*

7 DISCUSSION

7.1 Control vs. Uptake

We see an interesting tension between the strong interest of our participants' to spread their systems while they at the same time, to a certain degree, are working in a fashion that prevents this. None of the participants of our study was willing to let go of the internals and the code of their systems. This prevented any larger scale engagement around the system from other potential contributors. They were primarily interested in keeping control over problem solving and implementation of their system, which stopped others from significantly contributing to development and expansion of the systems. On the other hand, they have completed their systems (in terms of end-user finish) to a degree, which has allowed a large uptake in the community. In open source the whole concept builds on model of collaboration in which others are openly invited to work on the code. In comparison to this, the participants' way of working is more closed in the sense that they are keeping code and technology development to themselves. There are similarities though, to what is common in many open source communities in the sense that a central motivation for the creators is that they want to use the product of their creation for their own purposes [8]. Moreover, several of our participants have used their systems as stepping stones when looking for work, which is also common among open source programmers [5]. However, our participants differ strongly from the open source community on two critical points, the way of conducting their work, and the purpose of sharing. First, our participants work primarily on their own when it comes to coding their systems. They generally started from scratch, not building on existing work and did not invite others to collaborate in building their systems. Second, when they chose to share their systems, they primarily made the systems available for others to benefit in their orienteering and to get their feedback. They rarely released code for others to improve, modify, or build on.

7.2 Only a Few Build Systems

Although orienteering as a sport has a strong tradition of developing their own technology, it is also the case that not anyone in the community builds systems. The participants of our study share a similar set of experiences that influenced them in realising their systems: a) they were all skilled orienteers, b) had technical competence and interest, c) were central members of the community with extensive national and international networks. This set of experiences allowed them to identify central needs and opportunities in orienteering, realise this in terms of technical designs, and this allowed them to quickly reach and attract a potential user base. Worth noting is that our participants were not lead-users in terms of von Hippel [20], they did not have more extreme needs for technical support, or need for more thorough analysis than other orienteers. They were skilled and engaged orienteers - not unique or extreme in any way - which is something they shared with many other orienteers at their level.

A stated above, a success factor for the systems developed by our participants is that they build systems for a very specific community and activity, which they themselves are deeply involved in. This differs from individuals and groups in other communities building systems or contributing to existing systems. DYI and open source developers might not always have a clear picture of intended users. Even more so in collaborative systems such as Wikipedia [11], and ranking and review sites [2], the target group is large and unspecified. Despite these differences in conditions, our participants share certain motivational factors with for example Wikipedians who cite personal enjoyment as motivation for contributing [11].

7.3 Orienteering and Community Based Innovation

In this kind of community innovation, economic gain or increased social capital are not the primary drivers, rather the motivation to improve one's own orienteering performance combined with personal creativity lead them to put in substantial efforts in this largely unpaid work. Openness and sharing happened by making what they built available to their community, thereby becoming a way of putting their technologies to a test. The participants thus contributed to their community by building technologies that improve the sport for themselves, their peers, arena spectators, as well as spectators over broadcast.

It is clear that our participants have focused on orienteering as a sport and as a community in the development of their systems. They expressed limited interest in commercializing their systems, even though they did so to a limited extent. The common explanation was that orienteering is too small as a sport for commercial products to become profitable. Furthermore, none of them considered expanding their systems to other sports that share elements with orienteering - such as running or other sports with navigation elements such as sailing – even though their systems had several potential features for such expansions. We find that this stems from their firm personal grounding in orienteering, and their personal goals to improve as orienteers. As innovators and developers, they enjoy their sport and aims to create technology that support that enjoyment, as well as sharing it with other orienteers

7.4 Young Optimism

Common among the participants was how they all started out developing their systems as part of their university educations during particular courses or projects, in order to develop programming or project skills. Central to such courses is the often the completion of the task itself, rather than coming up with business viable solutions. Thus, when telling their stories, none of them had made any market analysis to ensure that their solutions were unique. Rather, they were perfectly happy to (possibly) reinvent the wheel. They focused on their project idea and in the end it turned out that their ideas were relevant to and attracted their targeted users. Moreover, since they were students they could devote fairly extensive amount of time during the initial phases of developing their systems. They all told stories of how they in later stages in their careers - when having regular jobs – they couldn't devote as much time and effort to the development. This changed their ways of developing their systems, for instance, as a student participant 1 took Winsplit to a professional finish with support from the Orienteering Federation, but later chose to release his other system - QuickRoute - as open source software.

8 CLOSING REMARKS

The primary conclusion that we would like to bring forward from our study regards the role that the community plays for the participants of our study. While the community is central to their endeavours of developing their systems, they are not representative of the typical member. On the contrary, they are examples of a minority that put in significant efforts of contributing to the larger group. Thus, our participants and members of the larger orienteering community complement one another as these systems get developed. Strongly related to this process is the mix of motivations that the participants display in the processes of developing their systems and the variety of sources of these. Some of these motivations are individually and personally driven while others are based on the participants' firm grounding in the community and their strong engagement for their sport. In describing this mix, their personal motivations to become better orienteers and solve challenging technical problems in combination with their strong will to improve and develop their sport emerge as dominating. Commercialization appears as a theme but all of them return to the fact that they do not want business to limit the potential benefits for the sport. Reaching a large number of users takes precedence over economic gain based on their systems.

Related to this, positive feedback and being credited for their achievements were central factors, but these efforts was not driven by getting established in the community. This is possibly due to the fact that the primary way of building reputation in the community of orienteering is to show skills and perform as an athlete. Building systems is not a core activity or skill for an orienteer. The participants already were established names in the orienteering community when their systems were beginning to get used. This mix of motivations and how they take dominance offers one way

of interpreting the way of working that the participants displayed. The forms of motivations that we see here and this different kind of collaborations and sharing of code and software thus differs from other community-driven activities such as in open source maker communities.

The participants that we have studied share characteristics similar to individuals for instance in a maker community [7]. At the same time there are some critical differences between these that we find interesting for mapping out the various the various ways that community based technology development may be like. While the sharing in maker and hacking communities often is concerned with sharing knowledge and skills of making and hacking, the sharing that we see in our study is about making a working product available for others to improve their orienteering skills and to get feedback on how the product could be improved. The community thus works as a resource in this kind of low-budget technology innovation. What we argue is unique about the case we have presented is that the technology development starts out from a few number of highly motivated individuals that through limited collaboration with others builds technologies that get extensive proliferation and use within the community itself, not only the ideas and requirements around it but the actual technology.

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