Emerging hackerspaces – Peer-production generation

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Abstract. This paper describes a peer-production movement, the hackerspace movement, its members and values. The emergence of hackerspaces, fablabs and makerspaces is changing how hacker communities and other like-minded communities function. Thus, an understanding of the nature of hackerspaces helps in detailing the features of contemporary peer-production. Building on previous work on 'fabbing', two different sets of results are presented: (1) empirical observations from a longitudinal study of hackerspace participants; and (2) a theoretical description of hacker generations as a larger context in which peer-production can be located. With regard to (1), research data has been collected through prolonged observation of hackerspace communities and two surveys.

1   Introduction and motivation

Hackers form a global community, which consists of multiple micro-communities [2]. The autonomous micro-communities are constantly on the move; evolving, mixing, forking, hibernating and dying. The hacker community exists both in the real and the virtual worlds, although the latter is often emphasized. The diversity and autonomy of hacker communities can be described through the different type of activities that hackers participate in. For example some hackers are more prone to do network related hacking while others might be more interested in social hacking. In the broadest sense hackers see the society as a system which can be hacked. Not all hackers are interested in the same set of technologies or programming languages. Some might be more interested in phones, hardware, games or biohacking.

   Over the past years hackers around the world, mostly in Europe and North America, have begun to move hacker networks and communities out of the virtual into the real world. They have begun to form hackerspaces, hacker communities

which have both virtual and real world bodies. The history of hackerspaces begins already in the 1990's. Farr [5] has defined three development waves in hackerspace history. During the early 1990's "[t]he First Wave showed us that hackers could build spaces" [5]. Examples of hackerspaces of the 90's are L0pht, New Hack City (Boston and San Francisco), the Walnut Factory and the Hasty Pastry. The second wave occurred during the late 1990's and European hackers (especially in Germany and Austria) began building spaces. The second wave also initiated early theoretical discussions about the development of hackerspaces. The second wave was about "proving Hackers could be perfectly open about their work, organize officially, gain recognition from the government and respect from the public by living and applying the Hacker ethic in their efforts" [5]. The third wave started after the turn of millennium. The amount of active hackerspaces in 2010 was 254 [15] and currently there are over 500 active hackerspaces around the world[1] and a few hundred under construction.

This proliferation of hackerspaces can be seen as a significant change in hacking and the formation of hacker communities. Hackers are setting up new kind of communities, with features unknown in earlier hacker communities. Since the hackerspace movement is relatively new, a simple and compact definition of "hackerspace" is still missing even among the persons who are involved in the movement. Different hacker communities use different names: fablab, techshop, 100k garage, sharing platform, open source hardware and so on. The variety of names for the new 'do-it-yourself' communities expresses the variety and diversity of the movement, which might be best described as a "digital revolution in fabrication [... which] will allow perfect macroscopic objects to be made out of imperfect microscopic components" [7]. Scientific attempts to clarify the differences of various 'do-it-yourself' hacking communities are still rare. A shared understanding of how to use the different descriptions and names of the movement is still missing, but some attempts toward a consensus exist.

2 Methodology and research questions

The hackerspace community has gone through several discussions about what a hackerspace is. Consensus has not been reached, but the discussions have brought up some criteria for what being a hackerspace means. Firstly, a hackerspace is owned and run by its members in a spirit of equality. Secondly, it is not for profit and open to the outside world on a (semi)regular basis. Thirdly, people there share tools, equipment and ideas without discrimination. Fourthly, it has a strong emphasis on technology and invention. Fifthly, it has a shared space (or is in the process of acquiring a space) as a center of the community. Finally, it has a strong spirit of invention and science, based on trial, error, and freely sharing information.[2]

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[1] Number is based on hackerspace list given in http://hackerspaces.org/wiki/List_of_ Hacker_Spaces which is maintained by the community.

[2] Naturally, not all members of all hackerspaces agree on the above criteria.

The five criteria have been tested by conducting a yearly survey of hackerspace communities. So far, the survey has been conducted twice, in July 2010 and June 2011. In addition to questions on the criteria, the survey contains questions which aim to provide more information about the values, interests and motivations of members of different hackerspaces around the world. The overall research setting contains elements of social anthropology and ethnographic methods such as observation. The author has been an active member of the hackerspace community both locally and internationally since 2009. The information gathered by living and working as a part the community is used in directing and conducting the research.

The research was inspired by discussions that have been going on through the hackerspaces mailing list (http://hackerspaces.org/wiki/Communication) for ages. The discussions have included several questions such as "What is a hackerspace? How can it be defined? Should some of the spaces listed in hackerspaces.org be removed or not? If so, based on what criteria?" The result has been almost always the same. Hackerspaces can and should not be defined rigidly, because that would create artificial boundaries and that is not a part of hacker culture or values. Discussions have involved business aspects, too. Some hackerspaces are more oriented toward business than others. It has been debated whether so called commercial hackerspaces should be seen as hackerspaces or not. Consequently, an interesting research question is the attitude towards donations (money, devices, equipment) coming from companies. Does the desire to be independent rule company donations out? What about governmental support? Is that more acceptable? Thus, questions on funding were added to the initial set of questions, that can be grouped under four headings: 1) What kind of hackers/people participate in hackerspaces? 2) What is the motivation to participate and 3) what do people do in hackerspaces? Additionally, 4) What is the bigger context of hackerspaces?

The latest survey was launched on June 16th, 2011 and was closed on June 30th, giving two weeks time to participate. A message about the research and a link to the online survey was posted to hackerspace discussion list (http://lists.hackerspaces.org/mailman/listinfo/discuss), the diybio list (http://groups.google.com/group/diybio/topics) and some other minor hacker oriented lists. The survey was not advertised in social media in order to avoid biased participants. If twitter or other social media would have been used in launching the survey, some non-hackers would have most likely taken the part. A reminder was posted a few days before closing.

The longitudinal survey discussed in this paper continues 2012 as P2P Foundation project, which can be found from http://surveys.peerproduction.net. All information collected with surveys will be anonymized and open sourced under Commons license.

3 Results

The survey in 2011 seems to confirm most of the results found in 2010. No dramatic

changes were found. (A comparison of the basic numbers from both surveys is presented in table 1.) Two hundred and fifty (250) participants (25 females, 223 males, 2 'no answer'; mean age = 31 years, range: 13-62 years) from 87 hacker communities in 19 countries took part in the study; in 2010 there number of participants was 201. The majority of the respondents were from active hackerspaces (90,4%). Similarly, the most of the respondents were members in only one hackerspace (90,8%). About 48% of the participants lived in Northern America, 39% in Europe, over 9% in Australia and 3,6% in Southern America. One participant was from Asia (China). None of the participants were from Africa. Compared to the stats of the survey in 2010, the percentage of European respondents dropped by nearly 9%, and hackers from Australia found the survey this year (8,7% up). The low amount of Asian respondents might be partly explained by limitations in access to web content (for example in China).

Table 1. General view of 2010 and 2011 survey statistics.

Basic statistics	2010	2011	Change
Participants	201	250	49
Men	185	223	38
Women	12	25	13
Mean age	30	31	1
Age range	15 – 53	13 – 62	-
Amount of different communities	72	87	15
Geographical distribution	**2010**	**2011**	**Change**
From Northern America	48,0%	48,0%	0,0%
From Southern America	0,0%	3,6%	3,6%
From Europe	47,5%	38,6%	-8,7%
From Asia	4,0%	0,4%	-3,6%
From Australia	0,5%	9,2%	8,7%
Amount of different countries	20	19	-1

3.1 Members – age, gender and education

The gender and age distributions of hackerspace community members follow the results found in FLOSS related surveys [1,14]. In 2010, the typical member was a 26-29 years old male (94%) with college level or higher education. In 2011, the typical member is a 27-31 (35%) years old male (90%) with college level or higher education (64%). It must be noted that even though 90% of respondents were male, this does not necessarily imply that the same applies to hackerspaces in general.
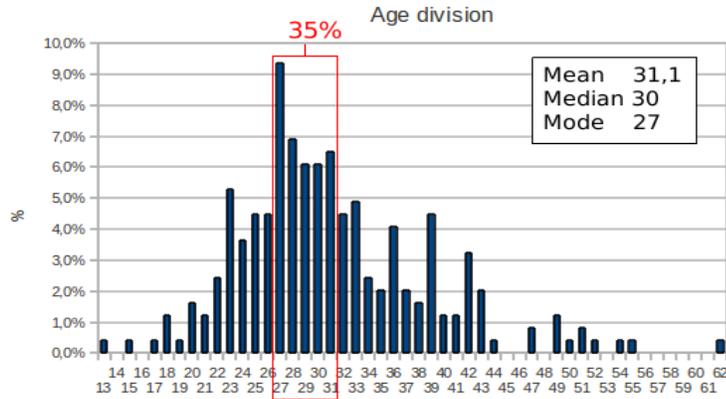

Fig. 1. Age division 2011.

When respondents are grouped by age, gender does not vary much (see Fig. 2). In both genders, 26 – 35 year old members are the majority (women 58%, men 52%). The minors (under 18 years old) are rare and only men.
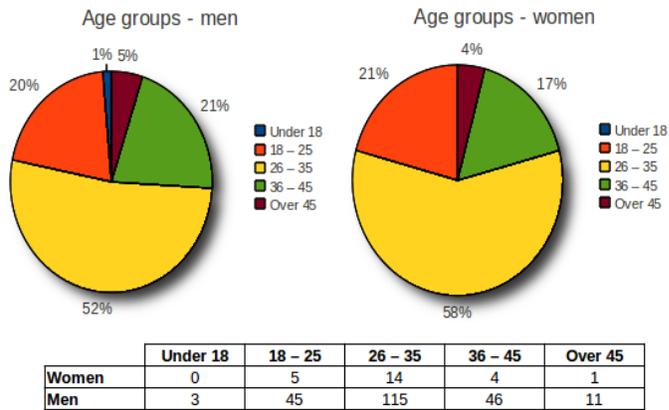
	Under 18	18 – 25	26 – 35	36 – 45	Over 45
Women	0	5	14	4	1
Men	3	45	115	46	11

Fig. 2. Age groups by gender 2011.

With regard to education, the only significant change between 2010 and 2011 is the increase in the amount of hackers with a Master's Degree. In 2010 it was 14% and this year it was over 20%. (Detailed comparison in table 2.)
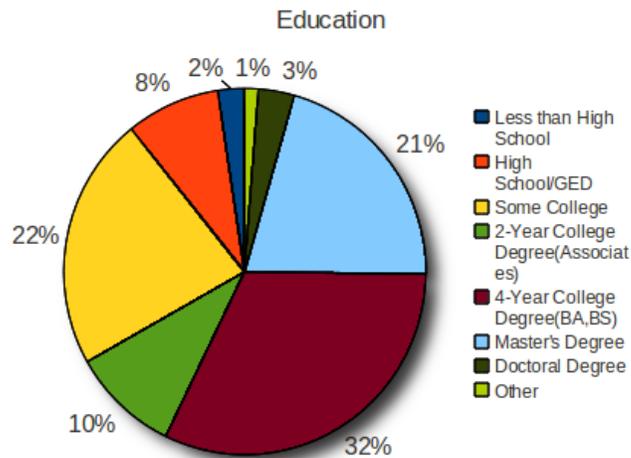

Fig. 3. Respondents' education in 2011.

Table 2. Respondents education 2011 and 2010.

Education level	Percentage 2011	Percentage 2010
Less than high school	3%	3%
High School/GED	8%	6%
Some College	22%	27%
2-Year College Degree (Associates)	10%	9%
4-Year College Degree (BA,BS)	32%	32%
Masters Degree	21%	14%
Doctoral Degree	3%	5%
Other	1%	5%

3.2   Members – membership

Based on the survey results, most hackers are members of just one community (nearly 91%). Compared to the results in 2010, memberships in two communities has dropped by nearly 7%. The trend seems to be that respondents are members in fewer hackerspace communities. This can be seen when comparing multi-community membership counts in 2010 and 2011 (see Fig. 4).
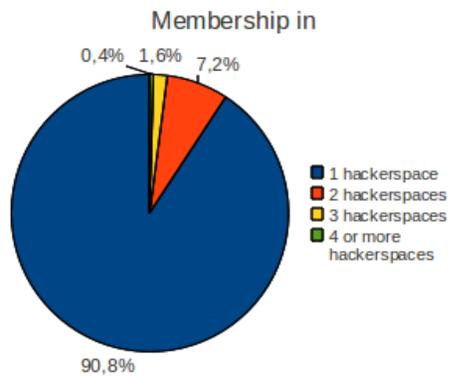
Membership in

	2011	2010	Change
1 hackerspace	90,8%	84,7%	6,10%
2 hackerspaces	7,2%	13,9%	-6,70%
3 hackerspaces	1,6%	1,0%	0,60%
4 or more hackerspaces	0,4%	0,5%	-0,10%

Fig. 4. Hackerspace membership 2010 and 2011

This might suggest that hackers have found their 'home' and are more engaged and committed to one local hacker community. This could be partly explained with the disappearance of some hackerspaces, causing membership concentration to strong and active hackerspaces. However, at this point this is just speculation and can't be confirmed from the data. Another possibility is that simply the raised participant count in 2011 has caused the change.

3.3 Members – interests

Members interests were inquired about in one question: "In general my interest with the hackerspace is MOSTLY about …". Respondents were given list of predefined groups of interest areas such as software hacking, networks and building objects. Respondents were informed to choose max. 3 options, but some selected all.

In the 2011 survey one new option was added: in 2010 the social aspects of hacking communities were not present on the list. Since then the need for that option has become clear. The term 'social aspects' refers to events and meeting people – the term was clarified to respondents in parenthesis. Respondents were also given an opportunity to choose 'Other' and give some sort of clarification. Figure 5 presents a comparison chart.

In general my interest with the hackerspace is mostly about

Category	2010	2011
Other	12	44
Game development	41	14
Security related	40	55
Mobile hacking/devices	109	59
Building Objects	111	206
Social aspects		167
Networks	43	56
Software hacking	98	162
Art	67	77

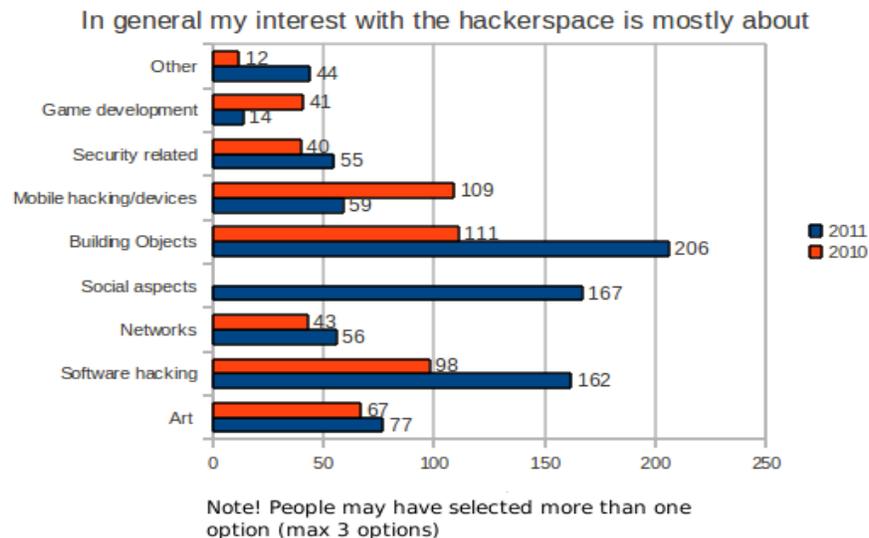Note! People may have selected more than one option (max 3 options)

Fig. 5. Interests in 2010 and 2011 in comparison

In the 2011 survey, the top three interests are building objects (82%), social aspects (67%) and software hacking (65%). Compared to 2010, both mobile hacking and game development dropped. Of course, adding the new option 'social aspects' might have partly caused the change.

Nevertheless, it seems to be clear that hacker communities are about building things. Option 'other' included several topics and areas as identified by the respondents. To mention just a few: learning, biohacking, biology, biotech, energy, diybio, robotics, 3D printing, chemistry, science & math, foundry work, fabrication techniques not available at home, podcasting, fibre-crafts and chemistry & physics. Among the above topics, the term 'Learning' appeared several times, which suggests that learning in general is important for participants. Also robotics and biology related hacking were mentioned several times. This suggests that hackers are getting more and more active in DIYbio (referring to communities focusing on biology), a fact that has also caught the attention of the press [see for example 4, 13, 17].

3.4 Members – Motivation

The participants were asked to tell how significant different reasons for contributing in hackerspaces are. The question included eight claims and options were presented using a five-point Likert scale (see Table 3).

Table 3. Motivation for taking part in hackerspaces – 2011.

	Strongly agree	Agree	Do not know/does not matter	Disagree	Strongly disagree
participate for the fun	69%	29%	2%	0%	0%
want to help people, without getting something in return	34%	46%	16%	3%	1%
participate because you re committed to the community	34%	41%	21%	4%	1%
want to help people and expect to get something in return	5%	24%	44%	20%	7%
participate to build up a reputation	10%	44%	26%	15%	5%
participate because need software/hardware improvements	12%	36%	30%	16%	6%
participate to earn money with it	1%	7%	27%	26%	39%
to meet (in real world) other hackers/hacker-minded people	70%	25%	3%	2%	0%

Altruism, community commitment, meeting other hackers in real world and having fun seem to be the most important factors of motivation. About 80% (last year 77%) of the participants seem to be contributing to community without expecting something in return. About 75% feel that commitment to community is one of the most important sources of motivation. For nearly all (95%) meeting other hackers and hacker-minded people and having fun (98%) are the most important reasons to participate in hackerspace activity. In other words, the social factor of peer production communities seems to be the key element.

When compared to results in 2010, no major changes can be found (Fig. 6). Attitude towards earning money and reputation building have become slightly less negative.
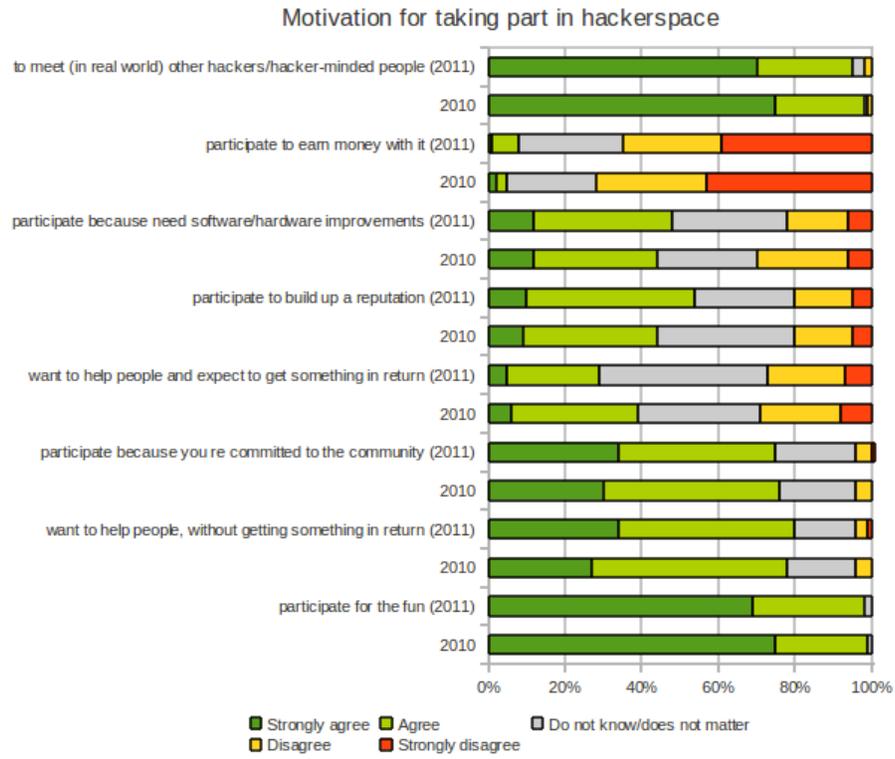
Fig. 6. Member motivations in 2010 and 2011 in comparison

3.5 Members – time spent on hackerspace related activities

Survey participants were asked to tell how much time they spend on hackerspace related activities in a week. The answers were given in free text format, not as predefined options (which could have been better). The responses were grouped into 2-hour periods and a few answers were dropped away: it seems highly unbelievable (and even impossible) that someone would use 300 hours or more on hackerspace activities in a week.

Roughly, the respondents use the same amount of time as in 2010 (2011: 10,6 hours and 2010: 9,7 hours). The histogram in Fig. 7 seems to suggest some changes. In 2010, two options – 4-6 hours and 10-12 hours – were most common, while other amounts were less popular. In 2011, the distribution is more even. It seems that respondents use either a little time (2-4 hours) or a lot of time (18 hours or more) in hackerspace related activities. The values in the middle got lesser hits. This might
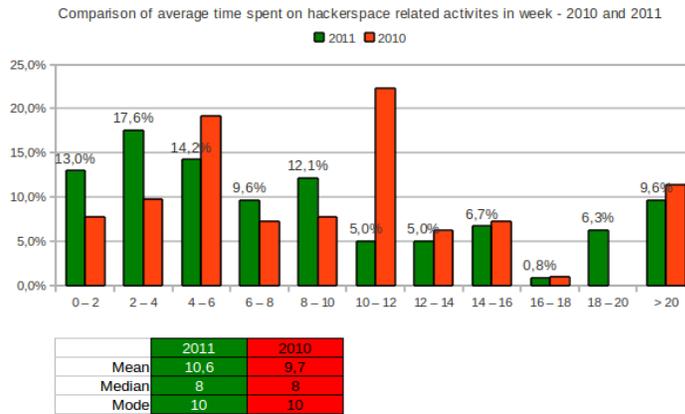
Fig. 7. Time spent on hackerspace related activities per week - 2010 and 2011

suggest that there are two groupings: 'the mass' (a few hours) and enthusiasts (high amount of hours).

3.6 Members – activity

The respondents participate in community related activities for about 10 hours per week. What kind of things do they do? The answer to this question was sought by asking: "In general my projects in the hackerspace are about ..." which was followed with 7 predefined Likert scale options. The given options were: Software development / hacking, Hardware development / hacking, Website/Web-app development, Management (financial or otherwise), Organize events/nights/sessions etc., Administrative tasks (email lists, servers, etc.) and Mobile device related hacking.

Results (see Fig. 8) suggest that hackerspace members are mostly involved in projects related to software development (over 55%) and hardware development (over 65%). The least popular project contents are Mobile device related hacking (6%) and Organizing events (less than 10%).
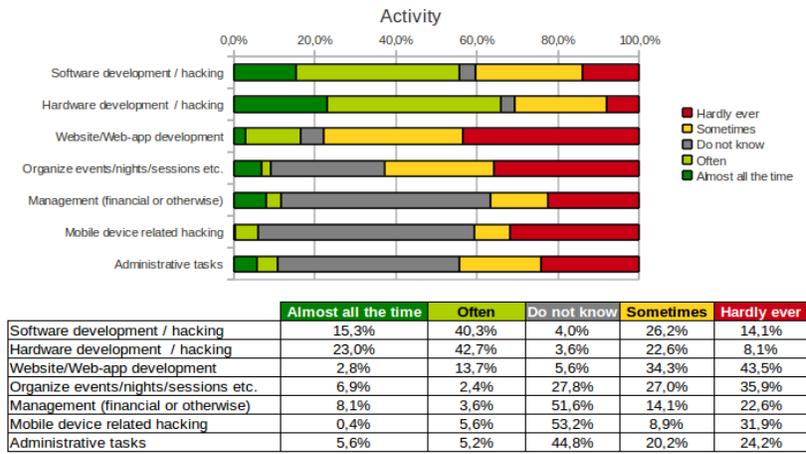
Activity

	Almost all the time	Often	Do not know	Sometimes	Hardly ever
Software development / hacking	15,3%	40,3%	4,0%	26,2%	14,1%
Hardware development / hacking	23,0%	42,7%	3,6%	22,6%	8,1%
Website/Web-app development	2,8%	13,7%	5,6%	34,3%	43,5%
Organize events/nights/sessions etc.	6,9%	2,4%	27,8%	27,0%	35,9%
Management (financial or otherwise)	8,1%	3,6%	51,6%	14,1%	22,6%
Mobile device related hacking	0,4%	5,6%	53,2%	8,9%	31,9%
Administrative tasks	5,6%	5,2%	44,8%	20,2%	24,2%

Fig. 8. In general my projects in the hackerspace are about ..." (2011)

Even though the amount of female respondents in the surveys was rather low, some cross tabulation using gender as one factor can be informative. I must stress that gender is not the issue here; it is used just for the sake of research. Keep in mind that hacker ethics does not want to use bogus criteria (such as gender, age or education) in evaluating people. The intention was to find out if there are differences between the genders; what men like to do and what women like to do. The results indicate that women are more often involved in website development (Fig. 10) and organizing events (Fig. 9).
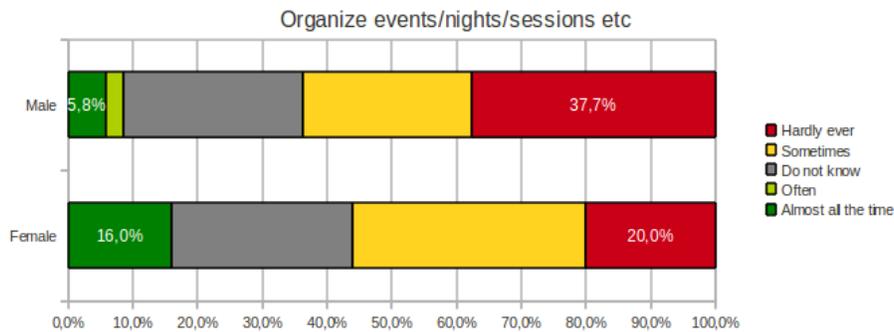

Fig. 9. Participation in organizing events by gender in 2011.
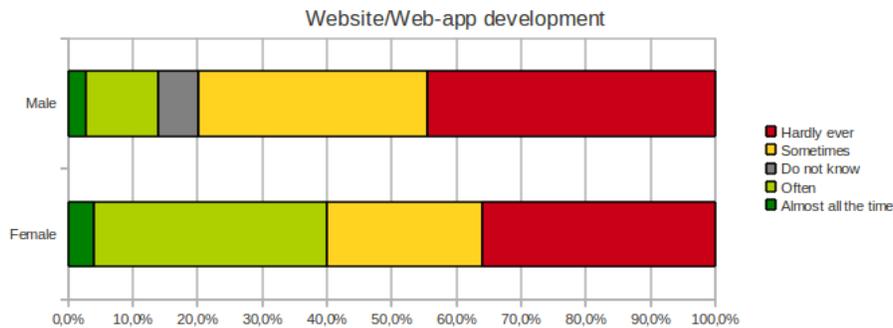
Fig. 10. Doing website related development by gender in 2011.

Men are more prone to software and hardware hacking. Women have strong interest in software development and a little less in hardware related projects. Mobile device hacking was not popular among respondents and it is dominated by men. Both genders are equally disinterested in management and administrative tasks.

3.7 Community – amount of members

A few of the questions in the surveys were about the local communities in which the respondents were members. For instance, respondents were asked to give estimated amount of members in their local community. This does not correlate directly to reality, since some respondents might be less aware of the status of their community. In other words, answers are probably mostly given by 'gut-feeling'. Furthermore, it is somewhat unclear how people understand the term "member", who is included and who is not. The question included predefined drop-down options: 1-10, 10-20, 20-50, 50-100, 100-200 and 200 or more. These options were constructed based on the 2010 survey results, in which respondents were free to give any number.

Estimated member count in my local hacker community

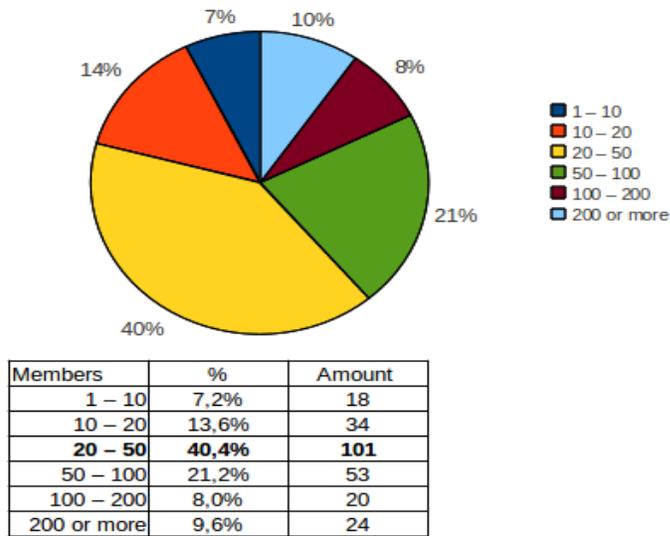| Members	%	Amount
1 – 10	7,2%	18
10 – 20	13,6%	34
20 – 50	**40,4%**	**101**
50 – 100	21,2%	53
100 – 200	8,0%	20
200 or more	9,6%	24

Fig. 11. Member count in local hacker community (estimated) in 2011

According to the results 40% of local communities have 20 – 50 members (see Fig. 11). The second most common size is 50 – 100 members. It must be noted that these figures include all kind of community statuses: planned, building and active.

3.8   Community – funding

The topic of funding was added to the survey in 2011. Discussions related to sources of funding have been constantly on the agenda inside hackerspace communities and therefore attitudes towards different funding sources are interesting. The survey participants were given a list with the following possible funding sources (with Likert scale options): company donations (money), company donations (devices, equipment, etc.), membership fees, governmental sources (aid from different programs which help building and maintaining volunteer activities) and donations from individuals (money or other resources).

From which sources hackerspace funding and resources can/should be obtained
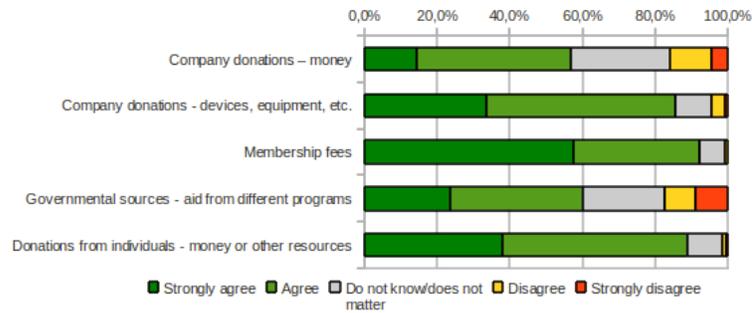
	Strongly agree	Agree	Do not know/does not matter	Disagree	Strongly disagree
Company donations – money	14,4%	42,4%	27,2%	11,6%	4,4%
Company donations - devices, equipment, etc.	33,6%	52,0%	10,0%	3,6%	0,8%
Membership fees	57,6%	34,8%	6,8%	0,8%	0,0%
Governmental sources - aid from different programs	23,6%	36,4%	22,8%	8,4%	8,8%
Donations from individuals - money or other resources	38,0%	50,8%	9,6%	1,2%	0,4%

Fig. 12. Opinion about sources for hackerspace funding and resources.

The results (Fig. 12.) suggest that company donations (money) are less disagreeable than governmental support, but only slightly. Membership fees seem to be the most approved source of funding. Device and other equipment donations from companies and all sorts of donations from individuals gained a lot of support. It must be noted that in some cases, if company donations are accepted, they must be without strings attached. The policy is required in order to maintain community independence from external forces. Nevertheless, it is clear that money or other kind of support in any form coming from individuals is preferred over company or governmental sources.

4   Discussion and conclusions

According to the survey results the typical hackerspace member is a 27-31 (35%) years old male (90%) with college level or higher education, committed to one hackerspace; he uses in average ca. 10 hours per week in hackerspace related projects, which are commonly software or hardware related. Altruism, community

commitment, meeting other hackers in the real world and having fun seem to be the most important factors of motivation. Compared to the motivation models discussed in research on open source development [for example 3], hackerspace communities have a strong 'social motivation factor'. The members in the communities have a high interest towards meeting other hacker-minded people in real life. Most communities aim to have a physical space that functions as a community center. They are also known to arrange a lot of real life activities which are often related to learning, education and of course having fun. Having fun is one of the most important motivation factors and having fun is a fundamental part of social life.

Women seem to have found peer-production communities (hackerspaces, makerspaces, fablabs, diybio, etc.). Peer-production communities are still 'man caves', but the amount of women in hacking seems to be rising at least through the hackerspace movement. The emergence of biohacking was also visible in the survey.

Hackerspaces can be seen as hacker versions of 'third places' as defined by Oldenburg [19]. According to Oldenburg 'third places' refer to social settings or surroundings separate from the 'first place' (home and other similar settings) and 'second place' (workplace) [19]. The third places are 'anchors' of community life that facilitate and foster broader, more creative interaction. These places serve as focal points of community life which has eroded due to commercial chains and unifunctional zoning policy [19]). Third places are needed to reconnect to each other and strengthen community ties. To become a successful third place, a place must be locally owned, independent and small-scale and be based on steady-state business [19]. Furthermore, the places should be highly accessible, within walking distance, free or cheap and involve regularity. When these criteria are compared to the characteristics of hackerspaces, the similarities become obvious.

All hacker and other computer related groups or clubs can not be called hackerspaces. Some groups or places that look like hackerspaces don't even want to be labeled as such. Some hackerspaces avoid using the word itself in the group's name or in the descriptions of the group. Reasons for avoiding the word vary, but the most common is related to the uncertainty of how 'others' will react to any description that includes or refers to the word 'hacker'. This fear of the opinions of others is an example of how communities are shaped, defined and identified also by people that are not members of the communities. The identity is not carved in stone, but constantly evolving. Yet some features can be listed even though the features are not universally agreed upon in the community. The reason for some level of diaspora may lie in the desire not to define hackerspaces rigidly, which in turn is derived from the values of hacker ethic.

Since a shared understanding of how to name the 'fabbing' movement is still missing (not the least in the academic context) and in order to put the movement in a larger context, I suggest that it could be seen as a continuum to the different hacker generations mentioned above. As discussed above, 'fabbing' is bigger than just hackerspaces and therefore I have labeled this new hacker generation as 'peer-production' (see Fig. 13.) in order to include the different forms described by Troxler [26].
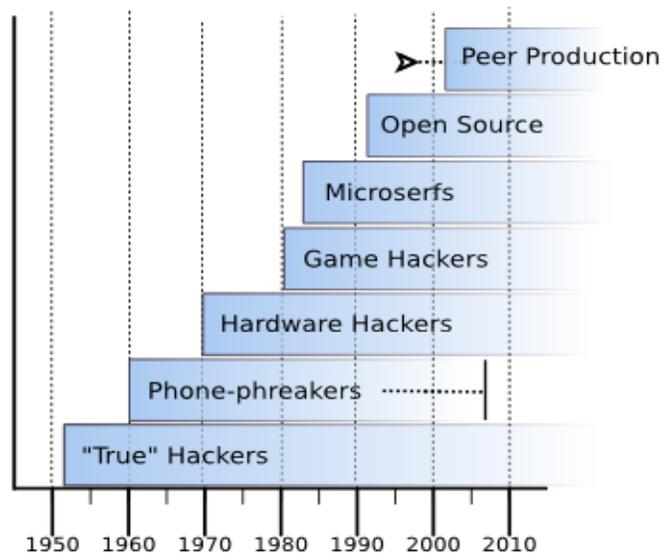
Fig. 13. Suggested view of hacker generations. Source: Modified from Taylor [24], peer-production added by the author. Beginning of peer-production generation is debatable. Hackerspaces emerged in small scale around 1995, but breakthrough happened around 2001-2002 and after that other forms of peer-production emerged. Phone-phreakers generation as a movement ends at 2006 because last "phreakable" MF-signalled N2 carrier was replaced with a T1 carrier.

While the above mentioned hacker generations are acknowledged by some scholars (see for example 23 - 24] the descriptions provided so far are missing the latest development, namely peer-production.

The description of peer-production movement as a hacker generation needs more research and thought. Nevertheless, hackerspaces as instances of peer-production have a clear identity and constitute a large, growing and global movement. Hackerspaces and previous hacker generations share some values such as altruism and believe in hacker ethic. As the survey results indicate, hackerspace members are if not obsessed then at least focused to hardware hacking, which was fundamental part of 'hardware hacking' generation. Peer-production generations adapts that obsession and extends it with social aspects. Peer-production generation overlaps with the Open Source generation as well. Both value sharing, collaborative work,

openness and transparency. Open source has become part of the main stream in software development. Companies have become part of the open source communities, started to form ecosystems and the border between working hours and contribution has become fuzzy. Hackerspace communities have chosen the other way. They want to stay as independent as possible from external forces such as companies and governments. This might indicate that freedom is more valued than resources. Valuing freedom over resources and restraining external (often business related) influences, does not exclude creating new business. Some of the fundamental parts of 3D printing device development (such as RepRap and Ultimaker) have started from peer-production communities.

Yet, hackerspaces are different kind of communities compared to communities formed by previous hacker generations at least in two aspects. Firstly, hackerspaces focus on social aspects in virtual and physical world. Hackerspace communities organize events, which are about having fun and learning. Examples of virtual events are monthly organized hackathons[3], in which people gather together to solve technical problems to create something new in collaboration. Physical world events are often educational in nature focusing on different technical issues and skills such as programming languages, soldering skills, 3D printing and biohacking. Furthermore, these events are often open to public. That indicates will to educate 'others', those who are not yet members of the community. Reasons for this free-time based education might be to lure in more members and share the gained knowledge and skills. Secondly, they aim to build and maintain physical spaces which function as community centers. Hackerspaces and alike have taken a significant role in how hackers and hacker-minded people organize themselves and activities.

5   References

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