Actor-Networks in Hacking Communities.

An Ethnography in Science and Technology Studies.

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Science and engineering always existed as a dual practice. Technological or scientific advancement was done not only in academic or industrial research laboratories, but also in workshops, garages and backyards. Those independent tinkerers called themselves "hackers". Within their own definition, hacker is not a cyber criminal but an skilful independent programmer, engineer or ingenious trickster. History of electronics and computing proves that hacker collectives and non-formal research groups were always important source of inspiration or challenge for the formal practice (Akera 2007; Levy 2010).

Hackers, while remaining highly individualised, always created the network of hackerspaces, computer clubs and freedom workshops (Coleman 2012; Maxigas 2012). While some parts of the movement turned to crime, others founded roots for computer innovations, creating Sillicon Valley. But the oldest European hacker communities are not much younger - German Chaos Computer Club held 30th anniversary last year.

During last three years, hackerspaces started to emerge in Poland. They are first establishments of these type in Central-East Europe (Zaród 2013). Not having financial or academic resources of their western colleagues, they declare to rely on the know-how of previous generation of Polish DIY, educated on Adam Słodowy's books and programmes (Słodowy 1984). Similarly to western practices, this experience should have influenced also more formal scientific and engineering practices.

Examining the hackers collectives might offer new insights not only on the independent tinkerers, but also on the whole "ecologies of knowledge" existing between universities, business, NGO and hacker actors. Classical sociological research (quantitative survey) on hackerspaces and 3D printing non-formal workshops is even more scarce (Moilanen and Tere 2013).

Observation made to this point, albeit limited in scope, shown unexpected connections: Technical university drop-outs designing probes for the professors from Polish Academy of Sciences. Art restorers consulting self-made wiremen about optimal scanning techniques. Biochemists designing their projects in the informal laboratories.

Creation of such communities provides unique opportunity to sociologically study mutual relationships between people, things and ideas. Crossing the boundary between science, technology and social sciences provides occasion for development of Science and Technology Studies in Poland and first large-scale application of Actor-Network Theory in field research.

Science and Technology Studies

Science and Technology Studies (STS) is a interdisciplinary programme of study, developed within discussions between sociologists, anthropologists and historians of science and technology after the Second World War (Sismondo 2011). One of the pioneers of this approach was Ludwik Fleck, who inspired Thomas Kuhn (Fleck 1986; Kuhn 2001). Another

important theoretical incentive, which is still relevant are the discussions on the Strong Edinburgh Programme (Bloor 1991; Barnes, Bloor et al. 1996).

Unlike philosophers of science, STS focused on empirical studies of contemporary laboratories. This period resulted in various "ethnographies of laboratory", among the most important are:

- "Laboratory Life" by Bruno Latour and Steve Woolgar, done in the laboratory of Jonas Salk (Latour and Woolgar 1986).
- "Art and Artifact in Laboratory Science" by Michael Lynch, done in neurological laboratory (Lynch 1985).
- "Manufacture of Knowledge" by Karin Knorr-Cetina, done in laboratories working in the field of agro- and biochemistry (Knorr-Cetina 1981).

Laboratory ethnographies shown importance of tinkering and tacit knowledge in everyday science practice (Law and Lodge 1984; Mackenzie 1990; Kalamaras 1994; Hutchins 1995; Latour 2013). Concept of tacit knowledge, which was proposed by Michael Polanyi (Polanyi 1967), was expanded to discover different types of experience (Collins 2010). One example could be ethnographic description on the problems with re-engineering the laser, connected with unspoken and unwritten assumptions existing between two teams from different countries (Collins 2010). Tacit knowledge is intrinsically connected with "Do-It-Yourself" concepts and manual tinkering issues.

Such studies also developed concepts as "epistemic cultures", describing unwritten set of rules and behaviours that differ one field of research from another. It might apply to authorship issues, collaboration patterns, distribution of responsibility or typical data or samples treatment. Epistemic culture might be described as the set of research actions (of human and non-human actors) translating facts from messy laboratory bench to the clean graphs in a paper. Research of epistemic cultures shown differences between research practice of physicists from CERN and biologists from Max Planck Institute (Knorr-Cetina 1999).

Despite importance in formal structures, STS research on DIY, tinkering and non-formal knowledge generation is still far from full understanding, especially because development of new tools reshape existing habits - for example when cheap biochemistry reagents influenced development of DIY synthetic biology (Roosth 2010). Sociology of engineering practice also explored importance of introduction of the new tools on the actual design practice (Vincenti 1990; Bucciarelli 1994; Henderson 1999; Vinck 2003). Several studies in STS also focused on artificial intelligence and robotics research (Collins 1990; Forsythe 2001; Suchman 2007).

In Poland STS research is done mostly on the theoretical basis. Several researchers connected with University of Mikołaj Kopernik in Toruń reorganized and commented various aspects of developments in these research programme. Krzysztof Abriszewski translated and commented major works of Bruno Latour (Latour 2010; Abriszewski 2012; Latour 2013). Łukasz Afeltowicz bridged STS with cognitive sciences (Afeltowicz 2012). Aleksandra Derra worked on historical and feministic issues (Derra 2013). Ewa Bińczyk focused on ecological risk issues (Bińczyk 2012). In result latest conference of EASST (European Association for the Study of Science and Technology) will be held in Toruń. I was also asked to review and co-chair in one of the tracks (H1).

Sociology and Anthropology of Science

Interest in science researched by sociological methods was not limited to STS. One example could be sociology of knowledge programme developed by Karl Mannheim and Max Scheler (Mannheim 1961; Scheler 1987). Strong Edinburgh Programme and STS could be considered

a form o polemic with this tradition. Since this project is more empirically oriented, those discussion have lesser importance.

Empirical, sociological work on science and technology was not limited to STS. Since the times of Robert Merton (Merton 1979), science was studied as an occupation within sociology of work (Lamont 2010). Scientific reflexivity was also discussed within ethnomethodology by Harold Garfinkel (Garfinkel 2007). STS findings found the later programme especially suitable for empirical research done within Actor-Network Theory.

Ethical aspects of engineering research (but not the DIY practice) was also a matter of study (Mucha, 2009) in Poland. It described ethical culture of Akademia Górniczo-Hutnicza (AGH University of Science and Technology in Kraków). Due to speciality (major "heavy industry" technical university in Poland) that research might be hard to extend to other spheres. Having in mind this restriction, this study still might be an important source of reference for the project. One reason is a lack of other data on engineering ethics in Poland. Second reason is that part of ethnographical observation in the proposed project will be made in Kraków.

Even more important is research done by Izabela Wagner on transnational mobility of scientists (Wagner 2011). She has conducted ethnography on various domestic and foreign laboratories for eight years. She interviewed more than 200 scientists and engineers. Prof. Wagner agreed to supervise this project. Issues of transnational mobility of scientists and artists already became the issue in the hackerspace ethnography, when several members of the local community had been found circulating between Palo Alto (their company headquarters), Moscow (where major cyber-defence tournaments are held) and City 1 (where they live and hack). Prof. Wagner contribution was recognized by STS community in Poland, as she was invited as a keynote speaker in EASST 2014.

Third source of theoretical inspiration will be anthropology of American hackers done by Gabriella Coleman (Coleman 2009; Coleman 2012). She focused on ethics and political involvement of hackers (hacktivism). Another source of inspiration might be ongoing works on makers' culture and open hardware movements (Bilkstein and Krannich 2013; Richardson, Elliot et al. 2013). Although useful as a reference, these studies do not cover several issues (e.g. local "ecologies of knowledge", definition of epistemic culture of the hackers, ANT approach to non-human actors.

This project will be mostly done by qualitative methods. Despite differences in theoretical frameworks (see below), several manuals and handbooks developed within general sociological tradition will be used to improve quality of data gathered during ethnography and interviews (Becker 1998; Babbie 2004; Garfinkel 2007; Emerson, Fretz et al. 2011; Silverman 2013). Especially methodological guidebook by Howard Becker already proven to be important assistance in devising ethnographical sensitivity. Certain "tricks of the trade" proposed by Becker (e.g. switching the metaphors, changing the scope of notes) were recommended by Latour, despite the differences in theoretical frameworks (Latour 2005). If ethnographers are scientific, why they should be excluded from the right to tinkering?

Actor-Network Theory

Actor-Network Theory (ANT) was developed basing on the tradition of ethnography of laboratories and legacy of ethnomethodology. (Callon 1986; Law 1986; Latour 2005). Series of discussions on realism and constructivism made within "science wars" shaped up several distinctive characteristics of this approach. Major guideline for discussing them will be outline made by Bruno Latour in "Reassembling the social" (Latour 2005). Major differences between ANT and other sociological traditions might be listed as five uncertainties:

1. **"No groups, only group formation".** ANT is a processual theory, it focuses on active processes. If the group-making process is not sustained, the group ceases to exist. This approach makes ANT especially useful for studying emerging techno-social collectives such as hackerspaces.
2. **"Action is overtaken".** Agency is an ability of actor that depends on networks with other actors. Those networks does not reduce agency, but extends or strengthens it. Depending on particular cases, those extensions might change aim of the action (mediators) or save initial aim (intermediaries). This "relational ontology" also implies that "local" metaphysics (devised by actors) should be carefully examined.
3. **"Objects too have Agency".** ANT differs from previous relational theories by including objects as an actors. This controversial claim should not be understood as essentialist stance, because agency of objects depends on connections not on the intrinsic qualities. By extending agency to non-human actors, ANT is especially suitable for techno-social assemblages. As one of the interviewees said: "Computer is sometimes extension of me, sometimes it is reflection and sometimes it is an independent being". Studying hackers without studying their computers will be incomplete.
4. **"Matters of fact" vs. "Matters of concern".** This fact calls for careful separation of worlds viewed by actors and worlds explained by general sociological theories. For example: working within ANT, one cannot say that "educational trajectories" explain biographical histories of hackers. One may only show how such explanation is used by actors relating to hackers (for example: faculty reactions when hacker try to find a position in the academia).
5. **"Writing down risky accounts".** ANT defines the text as a result of an empirical study. Text depends on financing, time and many other factors. ANT calls for self-reflexivity - for example: to note down changes made to the researcher during the study in line with changes made by the researcher. Ethnography is a method of discovery in social sciences, therefore it might fail, because STS shown that failure is an essential part of science.

In addition to these uncertainties, ANT offers several methodological guidelines for conducting the research. Some of them were developed within STS and shown in "Science in Action: How to Follow Scientists and Engineers at Work?" (Latour 1988). Others were included in "Reassembling the social" (Latour 2005). The most important issues are:

1. **Localize the global, distribute the local and connect the sites**. ANT crosses dichotomy between local and global by two means. First: ANT would not call any form of theoretical explanation, before providing solid evidence from fieldwork for date of reading / discussing the theory, title of the text and relationships between actor-networks changed by the theory. For example: If I wish to introduce notion of hackers' ethos to describe types of hackers' behaviour, I need to introduce and discuss this term with hackers or witness usage of this term during the ethnography. I also need to prove that texts on that ethos are used elsewhere (For example: this chronology of hackerspaces (Maxigas 2012) is quoted within internal discussions both in City 1 and in other hackerspaces.

2. **"We have to be as undecided as the various actors we follow as to what technoscience is made of."** (Latour 1988). It means that ethnographer should made

very limited preconceptions before starting actual fieldwork. As a a follow-up / polemist of Edinburgh Strong Programme , it calls for paying symmetrical attention to all actors involved in the study. It should be noted, that project leader, educated as an engineer, has qualifications to examine material aspects of the field.

3. **"We study science in action and not ready made science or technology; to do so, we either arrive before the facts and machines are blackboxed or we follow the controversies that reopen them."** (Latour 1988). Black boxes are processes described only by input and output, not by the internal mechanisms. This project follows this call, because it studies *first periods* of hackerspace creations in Poland. During this time, organizational principles, ethics and financial models are developed. Due to lowering costs of Arduino and accessibility of Internet programming courses (Zaród 2013), previous connections between universities, companies and indvidual beings might also be rearranged.

Several claims of ANT were criticized by various positions (Amsterdamska 1990; Collins and Yearley 1992). Discussions about theoretical ethics, items agency and realism have lesser impact on this particular study. Important problem with ANT is linked with term "culture". As other STS findings proven, examples of "epistemic culture" might be found among physicists, biologists and/or graduates of MIT or Cambridge (Mackenzie 1990; Knorr-Cetina 1999; Warwick 2003). For example: explaining trust between unknown actors (linked only by field or Alma Mater) is very hard to make using initial ANT methods. This project tries to overcome this limitation with following means:

- It is open for any documents and cases reported by any members of the hacking community (including the researcher). For example: When Polish hackerspace issued open letter to the Polish politicians about misuse of the word "hacker" (as a cyber-criminal), the researcher made and witnessed several talks on the issue, asking the participants about literature cases of hacking ethos.

- During the field work, special attention will be paid on the examples of "ecologies of knowledge" (Star 1995) or " trading zones" (Galison 1997) - situations, when different specializations work together. Both of those concepts will be included and verified in theoretical coding stage.

- It uses of method of elaborative coding during data analysis stage. This kind of coding enables comparisons with similar situations from sociological literature. After this coding, devised categories will be discussed with key informants or could be tested during field work (for example during the interviews).

Objective

This study is the ethnography done within Actor-Network Theory. Both of those qualities limit amount of theoretical preconceptions that could be made before the study. This study aims to explore group that does not have any prior sociological description in Poland and only scarce data available in international level. Both from ethical and methodological point of view, creating elaborated, formal hypothesis will be unwise.

If it will be possible, this research might examine processes of group formation done by hackers and other groups working with them. Initial findings show that some of the Polish hackerspaces take public stance about use of the word hacker in negative context.

If it will be possible, this research might examine whether hackerspaces could act as trading zones. Initial findings show that hackerspace could facilitate such exchanges.

If it will be possible, this research might examine educational histories of the hackers. Initial findings show that they often invoke personal experiences to explain certain situations.

If it will be possible, this research might try to explore community / individualism aspect existing in this epistemic culture. It might be compared with other studies (Knorr-Cetina 1999; Coleman 2012).

Whether such points seem to be interesting or trivial has lesser importance than paying full attention to all cases, when those explanations are insufficient or incomplete. Qualitative methods are more flexible than quantitative counterparts. During three years of the study, many of the conditions might change. In this sense, the only objective of this study is to follow the actors wherever they go, learn from them and with them and to describe the results as precisely as it could be done.

Significance

The project is the first attempt to describe hacking communities by the use of ANT. Situating the problem within STS research enables to explore educational, scientific and technological perspectives that were less visible within existing studies. Neither of the prior studies examined hackers in post-soviet country, nor it examined hackerspaces as a actor-networks in the ecologies of knowledge.

This study aims to observe *making* of such communities. In this sense it offers unique occasion to see creation of new actor-networks collectives. Delaying this study will mean losing some information from the field work. Independent tinkering is important issue for the economical, educational and cultural research. This study extends scope of "ethnography of laboratories" both to new geographical region and new part of the society.

It is the first large-scale empirical usage of ANT in Poland. It offers opportunity to practically employ and adapt approach that was used in Poland only in theoretical concept. It also presents opportunity to extend ANT to cover cultural differences or to merge elements of ANT with more classical sociological approach.

Work plan

Although ethnographical work is hard to schedule, the research is divided into six tasks. **Tasks one and four** form major empirical part of the research and cover observations and interviews done in City 1 - one of the biggest cities in Poland, where major economic and academic processes take place. **First task** will cover exploratory phase of the research. **Fourth task** will cover inspectional one and will be focused on verification of devised assumptions. Milestones for those tasks are completion of journals from observation and reaching interview .

Data analysis will be done in tasks **two** and **six. Second task** involve transcriptions, first stage coding and analytical categories development. Due to unpredictability of the research process it will be not ethical to promise certain number of publications. First stage of data analysis might result in mid-term analysis or methodological developments that could be published in *Studia Socjologiczne* or *Qualitative Sociology Review*. Possible journals for final publications are: *Science and Technology Studies* or *Science, Technology & Society*. Milestone for **task two** is set of categories and actor-networks to be verified in **task three.** Milestones and final project benchmarks for **task six** will be empirical chapters of the PhD thesis and scientific publications.

Tasks three and **five** have supporting role. **Third task** involves observation in another city (slightly smaller than City 1, but equally important in terms of educational capacity). **Fifth task** covers additional observations done outside of the Polish hackerspace communities (including travels to research partners in the UK). Milestones are similar to **tasks one** and **four.** Fifth task is the only one that will made outside of the chronological order, depending on the field situation. It allows ethnographer to explore and follow unexpected connections.

Table 1 - Schedule overview

	Task (Chronological order, except for task 5)	**Duration [months]**
1.	Etnographical observation in City 1. Interviews with hackers, businesspersons, academic staff. Short observations in collaborating institutions (if needed).	8
2.	Preliminary analysis. Interviews transcription, first stage coding. Categories development. Mid-term publications writing (if suitable).	4
3.	Etnographical observation in City 2 hackerspace communities.	4
4.	Follow-up ethnographical observation. Testing developed categories and concepts, looking for exceptions.	10
5.	Additional observations (depending on the need: academic laboratories, business, student scientific organizations or technical education issues, foreign hackerspaces).	4
6.	Final analysis (data processing, preparation of final publications, conference reporting, evaluation and financial reporting)	6

Methodology

Project will use extended case study approach, while also using ANT perspective to focus analysis categories (and observation) on machines and other non-human agents. By application of ANT, symbols will be linked with material practices and translations.

Preliminary research allowed access to majority of the researched groups. At the current moment, project author is kind of insider(as sociologist / tinkerer) in five DIY or hacking groups. Project Author also has experience in technical education and research practice, which will be used to enrich the ethnography with technological details..

a) Key researched groups:

- Members of the one of the hacking groups in City 1 Hackerspace (approx. 40 people to be interviewed in-depth). They initiated a regular meeting place for DIY programming, electronics and 3D printing. 2 months of observation were already made (Zaród 2014). This hackerspace community will be interviewed in two waves (during exploration and inspection)

- Members of the City 2 Hackerspace. They will be researched during shorther shorter period of etnographical research. Both hackerspaces are connected by the mailing lists, personal visits and projects.

b) Additional researched groups (to provide additional insight to key research):

- Foreign tinkerers from three European cities (possibly Amsterdam, Turku and Manchester or Berlin because contacts with those DIY groups are already established).

- Academic scientists (physics, electronics, biotechnology, automatics etc. departments) employed in formal academic institutions. 10-20 people to be interviewed in two cities, supported by shorter ethnographies. Partial contacts established in four cities in Poland.

- Business sphere: Programmers from small computing companies and start-ups. At least 10 people will be interviewed in City 1 and in City 2.

c) Data gathering methods:

Qualitative methods were widely used in sociology of laboratories and in development of ANT theoretical concepts. In order to maintain coherence with this perspective, this project uses similar approach. Another issue is adaptability – in analysis of highly dynamic social environments (like bustling Polish hacker movement), qualitative methods offer better adaptability. One exception will be the application of the automatic, computer-based data collection method connected with Internet connections within the hackerspace. Basing on those tradition, following data gathering method will be used:

- <u>Semi-structured, visible participant observation.</u> Observation is the key issue in every ethnographical practice. Empirical works of the STS are built on careful and long-term field work observations. In the key communities observation will last at least 18 months (8 months of exploratory phase, 10 months of inspection phase). In the City 2, observation will be made for at least 4 months. During each month of observation, at least 70% of the all days in month will be spent on the observation lasting at last for 6 hours each day. As it is time-consuming and emotionally exhausting task, it cannot be combined with other type of work. **Without the funding, this scale of observation is impossible to achieve.**

  Observation recording will follow best methodological practices developed within Chicago School (Becker 1998) and maintained by project supervisor (Wagner 2011). Similar guidelines were recommended by Latour (Latour 2005). Observation protocol involves jottings (as a temporary memory aid) and observation journal. Jotting will be written down to journal no later than 24 hours after each observation. In addition to

the normal research journal, additional one will be kept - describing development of thoughts, potential connections and questions waiting for the answer. Separation between precise, everyday records and personal thoughts will make data analysis more efficient.

Observation will be made in visible form, with acquiring informed consent from participants. Apart from regular observations, special attention will be put for special community meetings (e.g. hackathons held by one of the groups each month). Observation will also include recruiting 2 key informants in each researched groups (mostly already recruited). One of them will be experienced or group leader. Other will be newly accepted member. Such composition will proved additional perspectives for ethnographical data

- Semi-structured interviews. First turn of interviews (10 interviews in three different cities were already made) focused on biographical aspects (to find common trajectories to DIY groups). Second turn focuses on details of events found by ethnography. Additional interviews could also be made with third-party actors (e.g. Fab-Lab Gdynia operates as a city initiative, so responsible city official was already interviewed). Interviews will be recorded in audio form and transcribed as soon as possible. Interviews will be anonymous, according to the normal sociological ethical procedure. Due to the small and distinctive character of the researched groups extra concern will be made to achieve anonymity, while keeping specific characteristic of sociological research data.
  Transcriptions will be made personally by the researcher - due to idiosyncratic types of hackers' conversations, outsourcing this task might result in multiple errors. Part of the transcriptions will be made during the 30% free time between observations, rest during the data analysis stages.

- Quantitative data gathering. One of the communities agreed to provide data from Wi-Fi servers. Using simple Python (programming language, popular in the hackerspace) script, I will be able to receive information about number of machines used at the particular time at each full hour. This data gathering process will cover one year of ethnography. Combining this data with ethnographical notes will provide material for traffic analysis. While Quantitative methods are not widely used in ANT, this method enables to describe hacker-computer-smartphones assemblages. Integrating human and non-human actors in this measurement will be practical application of ANT methodological guidelines (Latour 2005). Basic analysis of variations and trends in the wi-fi usage is within my statistical and mathematical competence.

- Visual sociology methods might be used, depending on the particular need. Imporant application will be documenting stages of the design and construction of the artifact, documenting each step in order to visualize work of assembling (Latour 1999). If needed, good research practice will be built using also "classical" visual sociology (Gillian 2010).

- Supplementary methods (if needed). Internet ethnography (to maintain contact with remote groups). Netnography might be used is special cases, but it will be used mainly as tool in setting observational strategy. Example: Being part of the mailing lists, tracking and selecting events to participate. Project leader already used half-year internet etnography to study circuits and electronics research course (Zaród 2013).

d) Data analysis procedure:

Data analysis will be made in two stages. At the beginning of the each stage, transcriptions will be finished. If needed, additional interviews could be arranged. During the first stage (after exploratory part of the ethnography) key actor-networks will be identified basing on the

ethnographical notes and interviews. Selecting and defining key actor-networks before the observation will be unwise as it is against the best practice in the ANT (Latour 2005) and in qualitative research (Becker 1998; Blumer 2007). To facilitate the analysis, computer analysis tools will be used (Faculty has license for MaxQDA software). After writing down the key actor-networks, key informants will be asked to review and discuss them. Two stages of analysis are equal to two stages of coding.

First stage will also outline targets for the next observations and interviews. If hackers start to collaborate with the anarchist squats, I will interview the squatters and visit squats. If hackers start to work with scientists, I will interview the scientists and visit research laboratories. If hackers start to brew the homemade beer, I will not hesitate to follow them to brew and drink it with them.

During the second stage of the ethnography, proposed actor-networks will be closely observed (as a form of strength tests for the developed inscription) in order to find weak spots in proposed networks. If needed, findings will be extended and reworked to cover connections from different communities (e.g. to find information about relationship between the hackerspace and the local science community interviews with all parties will be symmetrically examined).

First stage coding will focus on descriptive and processual coding (from ethnographical fieldnotes) and in vivo coding (from the interviews) (Saldaña 2012). Second stage of analysis will focus on writing final research inscriptions - in form of scientific publications. Second stage of coding will use focused and in vivo coding (Charmaz 2009), with elements of elaborative coding to situate findings within other studies (Saldaña 2012). .

After the last stage of the analysis, open call for reviews from the researched community will be made - any interested hacker will be invited to discuss the findings. Following ethnomethodology and Chicago School guidelines (Becker 1998; Garfinkel 2007), ANT also pinpoints self-reflection of the researched groups in the final findings (Latour and Woolgar 1986). Project supervisor also used similar verification techniques (Wagner 2011).

Proposed networks will also be discussed with the ANT research community in Poland and UK, within scientific conferences, publications in journals or in personal communication.

e) Ethical issues

Hacker movement cause similar ethical concerns as research on other subcultures. Informed consent will be the obligatory issue in all ethnographies and interviews. Such consent will be negotiated in public in each researched group. All members of researched groups will be also individually asked for permission to be described in observational journal.

Due to highly specialized nature of analyzed processes, additional effort will be made on maintaining anonymity of researched groups. This project vagueness is a sign of this approach. All published quotations and observational details will be reviewed with key informants, in order to provide sufficient level of anonymity.

Another issue is legality. Project intentionally does not focus on illegal hacking in order to reduce both personal risk and ethical conflicts. Preliminary observations proven that separation of hackers (legal ones) from the “black hats” o “crackers” (illegal ones) is maintained within the hacker movement.

Difference between hackers’ ethos and formal technical researchers will be an important factor for research. While existing research does not cover exact composure of the researcher group, several works might provide supporting framework.

State of Research

Initial contact with researched groups was already established. From January to March 2014, three short-term observations. Basing on those observation City 2 was selected as a target for supplementary research. From April until June observations were made in the City 1. During this period at least 10 days in month were spent on observation (20 days in May). I also participated and observed several special occasions (e.g. public open data hackatons, public presentation of 3D Printer, hackerspace open day, cryptoparty).

Observation is supported by the interviews. 5. interviews with the members of the hacking community in City 1 were made, supplemented with 10. interviews with persons working with the hackerspace during special occasions (e.g. city official trying to integrate the hackerspace into city development strategy). That data was used to prepare publication (Zaród 2014), discussing various conditions of research. This publication will be also discussed during participation in Swedish Summer STS School.

In June 2014, Author has been accepted as a member of the hackerspace community. Few hackerspaces shared and commented on the selected works. I was also asked to prepare informational page about this research. This task is already completed.

Due to lack of financial support, ethnographical research will be suspended from July till September 2014. Only "sustaining contact" observations will be conducted. Without external funding, ethnographical work cannot be linked with full-scale employment.

Future research directions

Knowledge gathered within this project might be used to compare hackers and academic practices with DIY practices used by socially excluded groups (Rakowski 2009). Due to the ethnographical and ethical challenges, such task was not included in this project. Nevertheless, comparing mechanisms of electrical energy hacker practices remains excellent follow-up research perspective.

While this research aims to broaden up the theoretical perspective, it also presents interesting baseline for applied research in educational or scientific policies. Researcher was already asked to participate in preparation of digital competences educational framework. Establishing the dialogue between STS and educational research is one of the current research issue both in USA (Kaiser 2005) and in Poland (Zaród 2014).

Another possible outreach might be extension of the project scope to cover Polish counterparts of bio-hackers or synthetic biology research groups (Roosth 2010).

Risks and mitigations

Major risk for the project is lack of funding. PhD Scholarship at the University of Warsaw is neither sufficient to conduct full-time ethnography, nor it is sufficient to cover travelling costs. Ethnography is a matter of observing of living social changes - two months of half-time work cannot replace one month of full time involvement. This risk is partially mitigated by collaboration w PBIS Stocznia. Perhaps it will be possible to extend Polish American-Freedom Foundation Scholarship for the next period. Without funding it will be impossible to achieve suitable observation density.

Another risk is lack of experience in conducting ANT research. Whereas nobody in Poland has conducted large-scale research with this approach, project supervisor has extensive experience in conducting observations (about 8 years) and making interviews (above 200

interviews made). This risk will be mitigated by travelling to scientific conferences and participation in STS Summer School.

Third risk is connected with all types of ethnographical endeavours, it could be called "theoretical distrust". It is a doubt whether this ethnography provide meaningful scientific progress. This risk is mitigated by two factors. First: This project covers three years and enables observations in various places and institutions. Secondly - it focuses on less known and hermetic social group. Long terms of observation on the fascinating, perplexing world of hackers will likely result in new findings.

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