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## **Collaborative potential: designing coexistence in urban context**

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### **Abstract**

In this paper we discuss insights, observations and concepts derived from a case study: *StreetLab*, a co-design project on Information and Communication Technologies (ICT) that was performed in a socially challenged neighbourhood in Berlin, Germany.

A series of workshops was conducted with children and young teenagers exploring their perspectives on future communication technology. The study raised insights into general potential and challenges of cultural diversity in the context of *hybrid spatialities* and specifically into how such workshops inspire an interactive process on future design ideas.

The *StreetLab* was set up as a living lab infrastructure in a public space and created a platform inviting different interest groups like young people from the neighbourhood, governmental organizations, the team of design researchers and social scientists, as well as an industry

partner. Based on Action Research, Grounded Theory and Participatory Design, we held playful workshops on experimental use of ICT with more than 100 children from 10 different nationalities. Through the *StreetLab* workshops we learned about cultural differences in the children's approach to ICT, about a social gap when not having access to today's technologies, and about the curiosity and creative potential of children as designers of future innovations.

A major aim of this paper is to push further aspects of diversity and social sustainability into the design research process, trying to understand the differences in gender, culture, and social challenges when thinking about innovative technologies – seeing them as a general enrichment rather than constraint.

In this paper we will discuss different aspects of "designing coexistence", of which we mainly focus on participatory design research approaches and their potential for general social interaction.

**Keywords:** Design Research, Design as Infrastructure, Participatory Design, Intercultural, Young People, Urban Life, ICT, Living Labs.

## **Communities of practice in diverse urban everyday life**

Design always deals with people and their experience in individual contexts. Therefore, designers have to know how to connect to people – considering individual differences, social and cultural background, gender, age, and more. Design Research plays an important role in this context to reflect on how such connection can be facilitated in terms of methods as well as research and design processes. Considering current challenges in inclusive design and social sustainability, integrating design processes into a broader social context is a major driver also in today's development of future Information and Communication Technologies (ICT) from a design perspective. For ICT we observe the danger of the "digital divide" excluding people who are not addressed by the current conceptualizations of technologies. Hence, we have to cope with essential questions: How do we encounter the diversity of people's lives, especially when addressing them as users of tomorrow's ICT? How do we bridge the gap between High Tech and people's skills to interact with technologies? How do we link innovative technologies to people's actual needs?

At the same time, we face an inseparable conjunction of design and use as well as of designers and users, not least in terms of cultural constructions: design affects people, and people affect and determine design. Consequently design is in principle being received, grasped, adopted, accepted, refused, misused, interpreted in some way (Bieling, 2008) – in spite of being used in a way in which it was attended to be used or not. In her investigation on the *Everyday Metamorphosis of Things*, Brandes (2009) describes this phenomenon of Non-Intentional

Design (Brandes and Erlhoff, 2005) as the user's intervention in [or better: after] the design process by adding own, unplanned usages to existing infrastructures.

Design therefore acts in unavoidable alliance with social structure, social and individual acting, ergo with human beings and their behaviour. If we characterise *culture* as a symptom of how people treat each other (Delf, et al., 1988), and if we consider an improvement of interhuman dealings desirable, then it becomes comprehensible that design might potentially become an active helping part, especially if we attribute [at least] the ability to design [if not even the main task] to be a process-optimising discipline. As Herbert Simon (1969) describes it as an "action aimed at changing existing situations into preferred ones".

Integrating design into a broader social context therefore a crucial task. One approach to facilitate this integration is to include people affected by design into the whole development process – an idea that became popular already in the 1970ies in the Scandinavian movement towards Participatory Design (Ehn and Kyng, 1987; Ivey and Sanders, 2006; Sanders, 2002). Liz Sanders (2002) states that today, there is a noticeable shift from user-centered design to Participatory Design and co-creation in the field of human computer interaction (HCI). This methodological shift implies that the user is no longer regarded as subject of research, but as a partner in a collaborative research and development process. This is due to the fact that from a market perspective there is no longer such high value in triggering research and development exclusively from a technology perspective as ICT matures.

Standard methods from quantitative market research as well as e.g. questionnaires from a qualitative perspective failed to deliver such insights. The question is how to find out about latent needs and complex problems that occur in everyday life situations that could be a starting point for supporting technology. The main idea is to conduct design research in close interaction with potential users. They become actors in the research process and inform about their everyday life, behaviour, demands and desires. (Morajevi, et al., 2007; Sanders, 2008)

Design can be defined in general terms as an "undisciplined discipline [that] can comprehend the requirements and problems of our present time and is being urged to develop ecological, social, economical, technical and cultural possibilities of precise reflections and solutions for these problems" (Erlhoff, 2003). Based on this notion, one of the guiding questions for the research that we conducted was how design and ICT can both learn from and change phenomena in intercultural context.

According to Miettinen's (2006) understanding of Social Design, of which one of its main intentions is to improve and contribute to human well-being (Júdice, A. and Júdice, M., 2007, p. 45), and according to Margolin /Margolin (2002), who declare a social design project's main aim as to "satisfy the needs of underserved or marginalized populations", we aimed at literally meeting people in their everyday life contexts. Establishing empirical research directly in the

field in close interaction with people is a practice that can be traced back to the sociological approaches of action research and grounded theory. Here, approaches to group problems are sought jointly in “communities of practice” (Lave and Wenger, 1991) – in this case the problems are those that occur in everyday communication.

Wenger (1998) describes these communities of practice as “focused on a domain of knowledge [that] over time accumulate expertise in this domain. They develop their shared practice by interacting around problems, solutions, and insights, and building a common store of knowledge”. In terms of characteristics of such communities that lend themselves to support by technology, Wenger states that “technology platforms are often described in terms of features, but in order to really evaluate candidates for a technology platform, it is useful to start with the success factors of communities of practice that can be affected by technology” (Wenger, 2001).

## **Hybrid spatiality – living labs and infrastructuring communities and spaces**

In terms of research process, we draw on concepts from action research. In this concept, the research process is not bound to achieve a pre-defined result, with the theory being formulated after the event. At the beginning there are a number of initial hypotheses about the investigated group – for example that there are cultural differences in the significance and use of ICT among different social and ethnic communities. On the one hand the action research process provides insights about the communities themselves – through close interaction with them – while ideas for products and services are also developed with these communities in the participatory design process. They themselves become co-designers of their own products and look for solutions to their own ICT requirements. (Vaajakaljo, et al., 2009).

In this perspective, *StreetLab* left the controlled research environment and started an open dialogue with people in their everyday live environments pursuing a participatory approach to innovation.

Furthermore, it has to be seen in the context of “Living Labs” (Ehn, 2009; Reichel and Schellhove, 2008), an approach of creating an open infrastructure in everyday life context, where different actors in a design process meet. In the context of social innovation Ehn promotes the Idea of “Living Labs” as a hybrid space, where new ideas emerge from a variety of actors directly involved in the topic. This group of different stakeholders may range from end users, grass roots designers, technicians to local institutions and civil society organisations. The hybrid space opens up a playground for experimentation and co-creation with real users in real life environments, where users together with researchers, firms and public institutions look together for new solutions, products or services; a venue for open-

ended prototypical practices or arenas for communication and negotiations, which becomes accessible especially by participation in 'communities of practice' (Ehn, 2009).

In our approach we follow the paradigms of Participatory Design and Living Labs as open, hybrid research and experiment spaces. Our project included mixed interests, the social engagement on the one hand, and building up research scenarios for future technologies on the other hand. We therefore focused strongly on a close involvement of local communities, neighbours and local facilities such as youth clubs, to work together with our research and design team. In the following, we will discuss this open form of design research.

## **Setting up the streetLab**

As an interdisciplinary team of 10 researchers from design research, social sciences and educational science we set up a research laboratory in one of Berlin's multicultural districts Neukölln, in summer 2009. Aiming at getting to know the local communities better, we started experimenting, designing and developing ideas and concepts together with local children and teenagers, in order to gain new perspectives on communication technologies (Müller, Bieling and Lindenberg, 2010) and the interplay between digital media and public space (Law and Moser, 2001; Koch, 2004) in a young, urban and multicultural context.

The initial idea of setting up a research laboratory to explore local multicultural communities came along with the question concerning the location. To find an appropriate environment for *StreetLab* we carried out a field survey of various boroughs within Berlin. The location for our research project had to meet the requirements of being both a cultural and social melting pot. In view of growing diversification and the multi-ethnic urban society in the global context, we wanted to delve into heterogeneous urban neighbourhoods. Based on our personal everyday urban experience and prevalent media reporting we assumed a high creativity among the people in those diverse settings and wanted to uncover human experiences beyond academic networks.

We decided to build up the *StreetLab* in Berlin-Neukölln, in the boundary area of "Reuterkiez", one of the most densely populated areas in Berlin. The intermixture of trading, habitation and business covers the characteristics of everyday urban life. From the perspective of communal management and from an economic point of view the borough and its surroundings are considered as a socially disadvantaged quarter, caused by an unemployment rate of approximately 35% and a comparatively high child population [[www.reuter-quartier.de](http://www.reuter-quartier.de)].

The area Berlin-Neukölln has been in a state of flux for the last decade or more: It is not omitted by an ongoing gentrification. Besides "creative classes", namely students, media professionals and artists moving in, alternative bars, clubs and upgraded cultural events provide a social diversity. Simultaneously, clichés of Neukölln as a problem afflicted borough is

confirmed in the general public. We generally propose to see this as a chance for creative synergies in a dynamic environment and try to dismantle rigid prejudices about deprived areas.

To engage in this specific neighbourhood was especially challenging for the team of researchers as we could not anticipate the reactions and acceptance of our infrastructure. In preparation of the *StreetLab* the team contacted local youth clubs and schools for their support and took part in a four-days street festival with children and teenagers during the summer holidays. As location we selected an empty shop which we rented for three months in a lively street in the heart of the neighbourhood. The criterion of integrating our lab into the neighbourhood directed our decision towards renting a vacant sales store as research lab instead of putting e.g. a mobile container in the local space. Thus, we could access the local infrastructures more easily: additional to basic services (water, electricity, internet etc) we could use the advantages of social "street-life" by inserting our project into a dynamic local system. Besides getting to know our neighbours and certainly our (potential) workshop participants, it was definitely helpful, motivating and inspiring for us, to get in contact with resident persons and institutions, such as local shop owners [e.g. Doner Kebap, Kiosk, Bakery, Coffee-Bar, Second-Hand Store...].

These played an important role for bringing us in contact with specific people and the general situation and were therefore supporting our project complementary to other, rather official organizations in terms of strategic orientation, promotion and workshop collaboration. This network of partners included public institutions [Bezirksamt Neukölln: Jugend und Familie – Jugendförderung] and semi-public institutions, such as youth clubs [MaDonna Mädchenkult e.V., Sinneswandel gGmbH – Förderung gehörloser und hörgeschädigter Menschen in Berlin, Summer Playground "Platzspiele"]. Most of the partners were seated in Neukölln and had years of working experience with the local neighbourhood, its structures and people's habits, needs and problems.

Embedded into the local and social infrastructure, it was of high importance for us to provide a likable setting in order to establish a creative atmosphere for the children and teenagers. After a process of location scouting we agreed on the largely windowed, vacant salesroom. Its rooms appeared to be appropriate for the kind of scenery we required for the various parts of our work, that took not place in our ordinary institute's workplaces:

Welcoming and transparent to impart our idea of research, spacious but clearly arranged to perform workshops with the young and work jointly within the design research team. To expedite the project of the interior design of *StreetLab* was tackled with both, our finest do-it-yourself capabilities and the recycling of local second hand materials and furniture.

In this case the approach provided a rapid and low cost setup. Thus the rooms appeared more roughly and moveably than sterile and statically; Children and teenagers were invited to

vitalize *StreetLab* also by decorating and rearranging the interior with their handicrafts.

## **Open sources and implicit knowledge**

The participants were not seen as mere research objects, but were invited as experts on their own communication behaviours. Over the course of three weeks we offered open workshops with daily changing topics on communication, ICT and human-computer interaction. Including different aspects [e.g. patterns of use, sustainability, gender] the workshops were entitled for example: *Pimp your Mobile*, *SMS Poetry Slam*, *Power of Nature*, *Cell Phones "for Girls only"*, or *Sharpen Your Senses*. The questions that were addressed to the workshops covered the fields of e.g. Embodiment or Interactions and Musical Interfaces [Workshop: Free Style Music], Aesthetics and Innovative Functionality [Workshop: Mobile Phone of your Dreams], Alternative and Augmentative Communication [Workshop: Disability-inspired Interaction].

The results were put on display in the *StreetLab* in the form of sketches and ideas, prototypes, scenarios and stories. The feedback and appreciation was immense – more than 100 children from 10 different nationalities joined the *StreetLab* and engaged in a playful dialogue with the team of researchers. In the daily interaction with the children we learned a lot about their community, about their values and behaviour, about cultural specifications and barriers. We learned that the symbolic value of ICT is an important factor; that access to information could be a major aspect for equal opportunities in society; and that ICT can also be used in a quite playful and hands on way. Within such a short time, we had the chance to gather a lot of experiences in the direct interaction with children in their neighborhood – and therefore, understand in a much more profound way the issues and also the ideas concerning future technologies.

## **Research results and findings**

In our workshops and during the whole period of *StreetLab* we observed a variety of habits of communication and properties of interaction amongst the participants. These observations were based on both the prototypes that were built and on certain aspects of the kids' behaviour amongst the group.

These observations represented the basis for our ideation – the transfer of our insights into actual ideas and concepts. For our ideation and conception it was very helpful to cluster the findings into five categories: "Curiosity & Learning", "Communication & Sharing", "Identity & Culture", "Social Bonding & Relationships" and "Creativity & Playfulness".

It is important to mention, that the derivation from the observed aspects and the transfer into concepts does not always go the straight way [e.g.: a child builds a prototype with eyes on the

display, and we propose to produce mobile phones with eyes on the displays]. Rather we take some of the findings as a source of inspiration that might conclude in long-distance-transfers. This process of concept-idea generation might be best explained with the help of an example: The "Boomerang" Concept. In one of the workshops one participating girl built a prototype of a mobile device that included a little wooden boomerang on its backside. Her initial idea was to have a little analogue sporty gadget connected to her device that would allow her to play games with her friends in her spare time. In our ideation process that took place after the workshop period we had long and fruitful discussions amongst our Design Research Team on examples like that. In the specific case of the "Boomerang" this led us away from product-issues [such as may have been the original intension of the girl who built the boomerang-phone] and instead to interpreting her concept in a metaphorical way. This opened up a discussion about service- and even copyright-related issues concerning the exchange of data [e.g. sound files in P2P-systems]. Our interpretation of a "boomerang system" proposes a scenario of temporary file sharing and its usage. For example: Peter wants to show his favourite song to Mary and sends it to her. Mary can listen to it [maybe once, or over a certain time period], before it gets sent back to Peter again, just like a boomerang. If Mary likes it, she can of course buy it from a sound-data-platform [MusicLoad, iTunes, etc].

Thus in the research setting the prototypes themselves take the role of boundary objects (Star and Griesemer, 1989) fostering the dialogue between researcher and participant. These objects are "both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer, 1989).

Through the material language of the prototypes ideas became visible that would have been hard to verbalize. Therefore, the interaction with the team of researchers, the children and teenagers participating and the material artefacts formed an infrastructure of experience for our research questions.

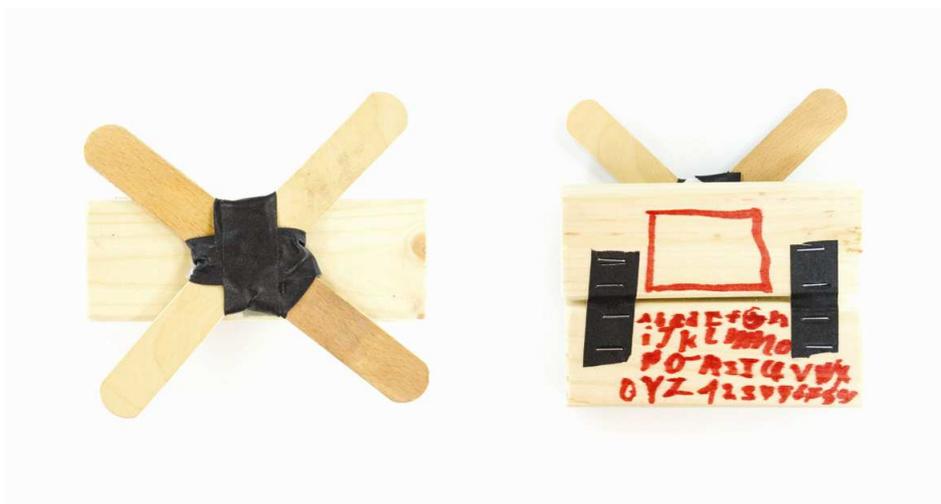


Figure 1: Boundary Object: The Boomerang – Starting point for interpreting concepts in a metaphorical way

In one of the workshops [“Futuristic Communication Devices”] which focused mainly on aesthetic, tactile and functional aspects, the participants could ideate and build prototypes of “ideal” and “visionary” communication devices. Depending on age, topic and motivation the built material was reflected differently by the participants. Independent of a verbal descriptiveness, implicit knowledge (Polanyi, 1966) was revealed here and led us to recognize different patterns. We clustered these prototypes to find communalities that would reflect on children’s needs and ideas on digital communication as well as on the emotional, symbolic, colour-, form-, material-related or functional qualities. Amongst the different patterns [e.g. “Strong Brand Impressions”, “Fur and Soft Materials”, “Figural Design”, “Sandwiched Multi-layering”, “Asymmetrical Numpads”]), one was striking: The pattern “National Identity”.

Some participants designed objects with an indication of their nationality on it, e.g. with national flags. We also observed in the children’s dialogues that they interviewed each other about their nationality. This fact seemed to play a major role in stating their identity and forming groups among the children. The merging identities of being born in Germany and having a cultural and family background from another country was addressed in their dialogues. The family’s cultural identity e.g. being Turkish or Palestinian was much more stressed, also to make a distinction to other children. The topic national identity was often complemented with microcosmic or local identity. Many kids gave themselves pseudonyms [which could be both a reference to HipHop/Graffiti Culture or Internet-Culture]. Many of these pseudonyms were combined with former postal codes of that area [Kreuzberg =36, Neukoelln =44]. Building up and representing a local identity as a complementary to [sometimes not clearly defined] national identities.

Using the device as carrier of the national identity draws on the communicative and symbolic function of the artefact itself. The need for personalization became quite obvious, too.



Figure 2: Examples for the pattern "National Identity".



Figure 3: "I am a Kurd!". One participant considered his nationality as the most important part of the device, rather than applications, functions, look or haptics.

## Discussion

Some of the research results were highly related to artefacts and their impact on social action. Hence, methodological questions were raised about how to describe and analyse them. This leads to the double role of the artefact: on the one hand it is conceptualized as a result of a process, incorporating implicit knowledge. On the other hand it can be regarded as a medium of communication embedded in the process, acting as boundary object (Star and Griesemer,

1989) between different points of view of different participants.

The question is how to deal with such forms of knowledge. How to exemplify it? How to make it ready-to-hand? In our case, interpretation and new-contextualising of the built material played an important role in addition to the observations.

It becomes obvious that the material language of the prototypes allows to recognize, to imagine and to discuss ideas, concepts, and scenarios that would have probably not been possible to verbalize; especially in context of working with children.

Knowledge gained within the research process has different kinds of representation: not only verbally but often through various visual or multi-sensual representations such as sketches, images, models or prototypes. Design knowledge [partially] resides in such visual and physical representations.

Design Research has the task of reflecting on these representations to make the encapsulated hypotheses an explicit knowledge. Design Knowledge is not only accessible through text, but also through other observations when experiencing an artefact (Cross, 2007), like touching it, considering an image, or trying out the functionality of a prototype. This specific form of Design Knowledge has certain similarities to the Mode 2 Concept (Gibbons, et al., 1994; Nowotny, et al., 2001) of scientific knowledge production. Mode 2 has been used to describe alternative forms of knowledge that is gained in a context-driven, problem-focused and interdisciplinary way. According to Gibbons, et al. (1994) Mode 2 involves multidisciplinary teams brought together for short periods of time to work on "specific problems in the real world". Its concept has to be distinguished from traditional research [Mode 1], which is academic, investigator initiated and discipline-based knowledge production.

Therefore, sketches, sound recordings, picture collages and prototypes from our project contain design knowledge in non-verbal, more tacit ways. The results from our investigation and experiment are therefore manifold and related to the specific context, situation, and to the participants. We used this kind of knowledge for deriving first design concepts and ideas how to shape communication technologies in the future – and hence, sketching visions about how to integrate ICT into everyday life contexts of children and teenagers with migration background.

## **Conclusion**

Following Wolfgang Jonas' and Alain Findeli's model of research-through-design (Jonas, 2006), we agree that design research activities go beyond the disciplinary boundaries to cause changes in the public domain. Research-through-design [or project-grounded research] must be transdisciplinary and should involve various stakeholders besides the researchers

themselves. In this respect, people are considered as being experts of their everyday living contexts. Therefore, we learned a lot from working together with those participating in the *StreetLab*.

To raise social awareness as a motor for both social and productive innovation, an important focus can be laid on the local dimension (Manzini, 2006; Manzini and Jegou, 2003). Bartholo and Monteiro indicate the importance of finding "the energy inside the local initiatives", and highlight the strategic designers' role in this systemic change. "Designers are to provide a bridge between the internal and the external conditions of the change so that local experiences that show innovative knowledge and possibilities can take place" (Bartholo and Monteiro, 2008).

It is therefore important to literally meet people in their everyday life contexts. Concerning cultural differences in the significance and use of ICT among different social and ethnic communities, we found that on the one hand the action research process provides insights about the communities themselves – through close interaction with them – while ideas for products and services are also developed with these communities in the participatory design process. If we had invited all the young participants to the laboratories in our university building, it would have led to other results and to totally different dynamics. But after all it has been this very energy that was created in the *StreetLab* which made our experience so special. It is why we like to underline the importance of taking design research onto the street.

We suggest such hybrid research settings with high user- and non-user involvement for a better understanding of real everyday life experiences, when aiming at overcoming "problems" and "barriers", and when thinking about innovative and future scenarios.

Here we should be aware about different relations of design to "problems". Ostman (2006, p. 8) points out, that a "*design problem* is not a single and simple issue, but rather a complex situation where we want to improve or change something. It is a situation of indefinite complexity, constituted by such major aspects as facts of nature values and social traditions". It is therefore "never purely technical matter" and demands "evaluation and ethical judgement", a notion that also relates to Rittel's Definition of *wicked problems* (Rittel, 1973).

In order to achieve its aim of creating new knowledge, as indicated above, Design Research therefore poses critical questions. These differ from those in purely technology- and business-driven approaches, and here lies the contribution of Design Research. Generally speaking, because Design Research questions address problems and opportunities in everyday life, they are necessarily interdisciplinary or undisciplined (Joost; Chow, 2010).

Here sociological and ethical questions must be taken into account. Participatory aspects in design inquiry are of particular relevance in contexts where the need for social change is a recognized and accepted objective (Diaz-Kommonen, 2002). Participation presupposes the

fostering of dialogue and the voluntary involvement of people in the development of themselves, their lives as well as their environment (Mikkelsen, 1995). Pelle Ehn has addressed this issue from the point of view of design as a discipline concerned with understanding the understanding of others (Ehn, 2001).

In the perspective of social innovation, we are generally facing the challenge to give access to technology to people with diverse backgrounds, e.g. differences in culture, education, or social environment. Therefore, we have to aim at a sustainable development of future technologies in its social, economical and ecological sense. In this respect, StreetLab was an approach to understand the meaning of social sustainability in a local community that is highly determined by challenges like low income, migration background and differences in culture. We used the StreetLab also as a platform to start a dialogue with people living in that neighbourhood – and therefore, getting first impressions about their everyday life experiences. ICT plays an important role within these communities, but people are challenged by the high costs of mobile communication today. Especially for the children we worked with, possessing a mobile device or any other ICT seemed to be an end in itself – besides the fact that sending SMS and calling friends and family was considered being standard amongst them. The change in social behaviour when introducing technology products into people's communities is therefore crucial to observe and understand.

The workshops with the children were highly playful and open in terms of results. Firstly, it was the aim to being in that environment and observing people and their behaviour. Secondly, it was the interaction with children and technology that inspired us for alternative ways of thinking and designing.

Against this background we consider the *StreetLab* project as a methodological case study how to integrate the needs but also the skills of people in their everyday life contexts into innovation processes. We encounter a different understanding of innovation in this respect – it is a participatory process that is highly entangled into aspects of diversity, local contexts, and experiment.

This open process of infrastructuring design also challenges the established categories of research as the results and the defined process are not clear from the beginning on – they emerge within the process. The results, though, are quite promising when exploring the field and the engagement into local neighbourhoods led to a holistic view on the context.

Therefore, living labs go far beyond user centred design approaches where people are most often conceptualized as “users” – that means in their role of using a certain artefact with a specific task in mind. In innovation contexts the approach of Living Labs as research spaces opens up broader views and interactions with people – literally including them into the research and development process of future innovations.

One central aspect of infrastructuring design in the social field is to create or imagine platforms that allow or support emancipated action by the people concerned. In terms of "designing coexistence", we want to highlight two aspects as important:

The first aspect relates to the phenomenon that wherever people from different, e.g. cultural or social backgrounds come and live together, different problems seem to evolve (Heitmeyer, 1998; Esser, 2000). We observed many of them. Based on these observations, we focused on concepts to encounter and avoid such problems, meaning that we aimed at "designing coexistence".

The second aspect relates to bundling competences. By bringing together design-researchers and experts-of-everyday-life revealing experiential and implicit knowledge in a participatory process, a "designing coexistence" [composed of these different actors] emerged.

Thus in this research field "designing coexistence" has a double meaning, in terms of both bringing together people in an inter- or trans-cultural (Welsch, 1999), as well as in a design-oriented sense. A social inclusion of "disadvantaged" or marginalized people can not <at> least be supported by their active inclusion into the design-/research-process.

## **Appendix**

As another aspect of designing coexistence, we could also name the concept of a hybrid research-locality, which aims at combining some of the qualities of both field- and laboratorial research. However this aspect is out of focus in this paper and will be discussed in another publication.

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