Deliverable D7.3
User Perspectives and Expectations

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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Executive Summary

This report presents the results of phase 3 of WP7 of the myCopter project package which is dedicated to the documentation and interpretation of the group interviews (focus groups). These focus groups were conducted in three European countries and had the aim to explore the perceptions and expectations which people have regarding this new technology. Key aspects of the discussion were the participants' feelings and impressions related to the existence and availability of PAVs (personal air vehicles) in their local environment and the issues and challenges associated with this travel option.

The focus group discussions were divided into two main parts. The first part was about the current local traffic situation and how people experience their way of traveling in the cities, especially their daily commute. After this collection of more general problems in current urban transport systems and options for improvement, the second part of the discussion started with a small narrative imagining the existence of small personal air vehicles available for personal commuting. This stimulus (the narrative) was used to familiarize people with PAVs as an additional transportation option and make them think about the concept of flying vehicles. In a first step of this second part people got time to get acquainted with this idea and to get answers to their questions regarding the characteristics and capabilities of PAVs and about the design and structure of the whole PATS (personal air transportation system) In a second step people were then able to connect challenges and issues they found with different PAV design options (business concepts, level of autonomies). The discussions brought out very lively and critical perceptions; potential challenges and solutions were voiced by the participants.

As a general observation from all three focus groups one could state that the topics discussed in this second part were quite similar in all three groups although they were mentioned in different sequences and depth. The major issues regarding PAVs that were raised are safety problems (on the ground and in the air for the PAV itself), environmental issues (visual impacts, noise), challenges with respect to infrastructure (city architecture, integration into existing ground traffic, maintenance & service), organizational and business models, level of autonomy and legal issues.

Table of Contents

Objective of the Report

The purpose of this document is to present the findings of the first year of the work package 7 (WP7) “Exploring the socio-technological environment of PAVs” of the myCopter project. The main goal of this work package is the insight into the socio-technological context and the infrastructural environment of a potential personal air transportation system (PATS). The operation of personal air vehicles (PAVs) raises plenty of questions about their potential impacts on society, and it is not clear what the expectations of society are regarding PAVs. As PAVs are not a part of everyday life for most people, we do not know what the demand for this form of transportation might look like and which design of PAVs and their associated infrastructure people would prefer. In order to shed light on these issues, a first step of the work package was to undergo a scoping phase and map the socio-economic environment of this new transport form. The aim was to identify the challenges and issues surrounding an actual realisation of a PATS and its integration into the existing transportation system in Europe (see Del. 7.1 of the myCopter project). This deliverable (Del. 7.3) now proceeds from the phase of literature research, expert interviews and discussion among the partners of the project consortium to a phase with external input by laymen.

The main goal of this report is the description of the focus groups discussions in Zurich, Tübingen and Liverpool. These group discussions had the aim to understand the perspectives and expectations of potential users in relation to PAVs and a potential personal air transportation system as a whole. The key issues discussed and the perspectives people expressed will serve as a valuable extension of the screening report (Del. 7.1) and will be used for the development of the final scenarios in Task 7.5.

1 Introduction

Since the 1950s civil aviation has experienced an extreme increase in numbers of passengers. In the second half of the 20th century the old dream of flying became a real option for a large part of the world population. It surely is safe to assume that such a development was hardly imaginable at the beginning of the 20th century.

Since then, the transport system has not experienced the successful introduction and diffusion of a completely new technology for mass transport again. Over the last 50 years we were able to observe a strong increase in passenger transport in the Western world and beyond, but this increase was based on the existing modes road-bound transport, rail, waterways and civil aviation. Concomitantly, a shift from public to private transport could be observed over this period. In EU-15 countries, for example, we now have between 500 and 600 cars per 1,000 inhabitants. In Germany, 36% of the households did not own a car in the 1980s, whereas in 2010 this share was only 18%.

Nobody knows how the future will look like; but there a hints pointing at changes in the transport system. On the one hand, there are new technological options. Technically spoken, flying is not a challenge anymore. On the other hand, it can be observed that our transport system is reaching its limits under several aspects. Congestion and the waste of space for new roads are serious challenges to the economic growth and the quality of life in European countries. There is the problem of GHG emissions and serious impairments to health caused by air pollution. Against this background, it could be argued that it is time to think about new options for the transport system. From the perspective of science and policy making, it is important to get prepared for future transport options. Transport infrastructures are long-lasting systems; it is crucial to early anticipate future transport innovations in order to be able to govern them in a most responsible and sustainable way.

These are the kinds of observations and reflections which are motivate the FP 7 project myCopter. On its homepage, the project describes its missions as follows:

Considering the prevailing congestion problems with ground-based transportation and the anticipated growth of traffic in the coming decades, a major challenge is to find solutions that combine the best of ground-based and air-based transportation. The optimal solution would consist in creating a personal air transport system (PATS) that can overcome the environmental and financial costs associated with all of our current methods of transport. We propose an integrated approach to enable the first viable PATS based on Personal Aerial Vehicles (PAVs) envisioned for travelling between homes and working places, and for flying at low altitude in urban environments. Such PAVs should be fully or partially autonomous without requiring ground-based air traffic control. Furthermore, they should operate outside controlled airspace while current air traffic remains unchanged, and should later be integrated into the next generation of controlled airspace. The myCopter project aims to pave the way for PAVs to be used by the general public within the context of such a transport system. The project consortium consists of experts that can make the technology advancements necessary for a viable PATS, and a partner to assess the impact of the envisioned PATS on society (socio-technological evaluation).

The main objective of work package 7 of the project is to assess the requirements for as well as the positive and negative impacts of implementing PAVs into the transport system. Introducing a new mode into the transport system is not possible without a certain extent of acceptance by its users and citizens. Governing transport and traffic is a very complex issue that includes many different socio-technological aspects. Transport planning must mediate between various influences such as economic interest, environmental protection, land-use planning issues, human health, safety or social equality. It must take into consideration

technical innovation, quality standards, habits, standards of living, ideological visions and other factors. Since all citizens are somehow involved in transport and traffic issues – most of them a few times a day or all day long when it comes to noise – public interest in transport measures is in general very high and more or less intensive conflicts about issues of transport planning occur quite frequently.

Like any innovations, PAVs have to be adapted by the users and accepted by the public. There needs to be support from politicians for the diffusion of a new transport technology. In particular in the transport sector public acceptance is usually driving political acceptance (see Banister 2008). Against this background, it is of utmost importance to understand the perspectives and expectations of potential users and/or citizens when carrying out a Technology Assessment for PAVs.

The document at hand is deliverable 7.3 of the myCopter project. It describes the empirical findings of user perceptions and expectations related to the introduction of PAVs.

2 The Focus Group Method

Focus groups are an established method of qualitative social research. Conceptually, this method is remarkably old – it was described in literature already in the 1920s, e.g. by Bogardus in 1926. However, until the 1990s little attention was paid to this method and it was rarely used in scientific contexts because of a lack of systematic development (Morgan 1997). Currently, focus groups experience a revival and numerous handbooks were published (Bürki 2000 and literature therein). The focus group method was adapted to several kinds of objects of research, starting from market studies to medical research (e.g. Morgan 1997; Powell and Single 1996). Thus, variants of the method got different names like focus groups, group interview or group discussion.

In general, focus groups are moderated discussions about a defined topic with a group of 7 to 20 participants that are selected according to defined criteria (Morgan 1997). The participants of one focus group usually share one attribute (e.g. are all inhabitants of the same city), but are assembled for maximum diversity in all other attributes (e.g. age, sex, social and professional background). Usually the discussion is triggered by a thematic input that provides information on the topic (e.g. written text, verbal statements, short movie or slide show). In general, the discussion should take place on an equal level of knowledge on the selected topic or at least a common basis (e.g. Morgan 1997; Bürki 2000). The moderator of the focus group takes care that the conversation stays close to the topic by using an interview guide (Merton and Kendall 1946). Nevertheless, the participants should mostly talk amongst themselves rather than with the moderator (e.g. Bürki 2000; Barbour 2007).

One aim of a focus group setting is to create an everyday life-like conversation situation among the participants in which they should be able to express their opinions and points of view in their own words to the other group members – this interaction is the crucial feature of the focus group (Kitzinger 1994; Kitzinger 1995). In the analysis, this allows a better understanding of the relations of the statement with the participant's everyday life and insights into the backgrounds and foundations of certain arguments. Further, the focus group discussion intends to feature the positions on which consensus might be reached in a certain group, its contexts and justifications, as well as reasons for disagreements within the group.

Another aim of focus groups is to reveal aspects of an issue that are new to the researcher. Moreover, focus groups allow eliciting the most salient issue as well as the reason why the issue is salient (Morgan 1997) and hence provide ideas for approaches to link people's statements to their real behaviour (Lankshear 1993). As a researcher, one can learn which viewpoints are shared by a number of people, how these viewpoints emerge and what the reasoning behind them is. Thus, focus groups can give important hints for further research and provide information about complex attitudes and attitudinal patterns.

Notably, the outcome of focus groups is not considered as a mere collection of single opinions. It should give an account of the opinion within a group as a product of interaction while retaining the variety of positions among the participants. Hence, the focus group's outcome cannot – and does not – claim to depict representative statements about a certain group of citizens or the society in general, not least because of the small number of participants (Bohnsack 2003).

Having listed a number of strong arguments for using focus group interviews, some disadvantages of the method should be mentioned as well: One is that the research team cannot completely plan interactions, the flow and directions of the conversation. Even the moderator can only influence them to a limited degree (Morgan 1997). Moreover, since participation is voluntary and the participants need a motivation to join the discussion, there will always be a certain, hard-to-control ("self-recruitment") bias in the composition of the group. Another point difficult to balance is the unequal previous knowledge of the participants. This is especially important in discussions about complex issues such as science and technology. The initial thematic input is crucial here but can nevertheless just provide a common (lower) basis of knowledge. Connected to this, but also due to personal characteristics, there is always the danger of one or a few participants dominating the others by either taking more than their share of speaking time or trying to persuade other participants. One last critical aspect that is especially worth having in mind when organising focus group interviews about issues such as future technologies is that some of the attitudes mentioned in the course of the discussion may be "artefacts", because people often do not think and talk about these issues in their everyday life, do not know them and use analogies and metaphors to make themselves familiar with these topics. In this regard, the context of the whole event is important as well as participants' interaction with each other and the moderator. Nevertheless, most of the above mentioned potential weaknesses of this method can be eliminated by careful preparation and sensitisation of the moderator and other research personnel.

3 Design & Analysis of Focus Groups

Three focus groups were prepared in three different countries (Germany, Switzerland and the United Kingdom) and conducted in November 2013 and January 2014.

As a preparation for these focus groups a "test focus group" with eleven students from KIT, mainly having a background in engineering and economics, was conducted in May 2012 in Karlsruhe (Germany). The title of the one-day focus group was "New Dimensions of Urban Traffic" and this event was used to test the structure of the planned future focus groups of the myCopter project and to facilitate the development of key questions. Furthermore, the key issues and challenges mentioned by the students in Karlsruhe were a good confirmation of the challenges identified by the project team itself so far. The test focus group was divided into three main parts:

Part I: Mobility behaviour of the future (duration: 1h)

- What are the problems and challenges of **today's** urban traffic system?
- What are the challenges for the **future**?
- Future trends: where are we going to?

Part II: Confrontation with 3rd dimension as an option & development of design parameters/ requirements (duration: 1.5h)

Participants were asked to imagine the availableness of flying vehicles:

- What role could PAVs play for daily life and commuting?
- What could be their role for other purposes and target groups?

Part III: Development of PAV & PATS visions (duration: 1.5h)

- How would a PAV look like which would meet the requirements developed in part II?
- How would the whole PATS be designed and organised?

In contrast to the test focus group in Karlsruhe, the three following focus groups did not consist exclusively of students but of participants from the general public (GP, inhomogeneous sample desired). The two focus groups in Liverpool and Tübingen additionally included a flight simulation.

Table 1: Overview of myCopter focus groups 1-3 and test focus group

	Zurich (1)	Tübingen (2)	Liverpool (3)	Karlsruhe (pretest)
participants	GP	GP	students & GP	students
simulation	no	yes	yes	no
duration*	4h	6h	6h	6h
number of participants	12	11	10	11
expenses/ payment	150 SF	80 €	80€	50€

* discussion time including breaks

Table 2: Focus group composition

	Zurich (1)	Tübingen (2)	Liverpool (3)	Karlsruhe (pretest)
gender	6 female & 6 male	5 female & 6 male	4 female & 6 male	4 female & 7 male
age	19-66	18-55	21-53	21-29
interviewer	Torsten Fleischer	Torsten Fleischer	Torsten Fleischer	Torsten Fleischer & Jens Schippl
documentation	Michael	Sarah Meyer-	Sarah Meyer-	Sarah

	Decker (tm), Sarah Meyer-Soylu (tm); Ursina Mögerle (t)	Soylu (tm) Jens Schippl (tm) Sabine Krings (t)	Soylu (tm) Julia Hahn (tm) Thomas Fell (t)	Meyer-Soylu (tm); Sabine Krings (t)

tm = time minutes and observations; t = transcription

3.1 General Structure of Focus Groups 1-3

After the pretest focus group the design was slightly changed. The first part remained quite similar, but a stronger focus was put on the current local situation. In the second part, the participants got more time for comprehension questions and to develop an understanding of the PAV vision. Part II und part III of the earlier structure were also merged because experience from the pretest group showed that the discussion was overlapping and no clear and reasonable differences were added.

To summarize, the focus group discussions finally had the following structure:

Part I: Perceived current local traffic situation (duration: 1-1.5 h)

- What are the problems and challenges of your daily commute?
- What are the general problems of your local **today's** urban traffic system?
- What could be improved on the existing situation?

Part II: Confrontation with the PAV idea: Using the 3rd dimension as an option for individual travel. Imagine the existence of PAVs as a new transportation option in your mobility behaviour (duration: 3h)

- What are your impressions regarding this traffic option?
- What else would you need to know?
- How do you like this idea (exiting, crazy, attractive, unbelievable)?
- Assuming that 10% of rush hour traffic would be redirected up into the air, what would happen, how do you like this idea?
- What would be your preference: to have the full-autonomy option or a semi-manual mode?

3.2 Recruitment

The recruitment for the focus groups was done either by the myCopter internal partners from Liverpool and Tübingen or, in the case of Zurich, by an external service provider.

3.2.1 Recruitment Focus Group Zurich

The recruitment was conducted by a Swiss market research bureau (publitest – mafo concept GmbH) based in Zurich. A high interest in participating in the focus group event could be noticed and 12 people were finally invited. The sample had a broad age range (19-66 years) and a balanced mixture of gender.

3.2.2 Recruitment Focus Group Tübingen

In Tübingen a database with around 800 registered test persons who were already involved in experiments for the MPI (Max Planck Institute) was used to contact persons for the focus

group. Because an inhomogeneous sample regarding age, gender and professional background of participants was desired, an e-mail asking for these information (which were not available in the database so far) linked with an invitation to the focus group event was sent out to all registered persons. From the 17 positive responses, 12 people were selected and invited to the focus group. The selection was done to ensure a balanced age sample, male and female mixture and professional background composition. From the 12 invited persons 11 participated in the focus group event.

3.2.3 Recruitment Focus Group Liverpool

In Liverpool the recruitment was done by the internal partners from the University of Liverpool. They distributed an e-mail invitation to attend the focus group to the staff and students of the University. This led to seven respondents. To increase the number of participants to the desired level and also to improve the gender, age and professional background balance of the group, a number of additional people were specifically targeted for invitation. This resulted in a total number of 11 volunteers, of whom 10 participated in the focus group event.

3.3 The Narrative

After the first part of the discussion about the perceived situation of their daily commutes and, more general, the traffic situation in their city, people were asked to follow a small story line told by the moderator. The story went like this:

> *"Imagine, one day in a not so far future, there would be vehicles with space for one or two persons, but they would not really be like cars. They would be able to fly and therefore bridge the way from home to work by travelling in the air.*
>
> *What else would you like to know from me to be able to follow or even develop this story further?"*

Following this small introduction, people were very eagerly asking for more information and giving first statements. A ping-pong of short questions and answers developed over the first minutes.

3.4 The Flight Simulation

In two focus groups (Tübingen and Liverpool) a flight simulation was used as a supplementary stimulus for the discussion which should help people to imagine using a PAV by themselves and guide their attention towards additional features and feelings about this transport option.

The simulation was based on a morning commute from home to work. It included elements of automatic (take-off, part of cruise, landing) and manual flight (once cruise altitude and speed have been reached), with most of the time the autopilot being in charge. During the manual episode the autopilot was partially disengaged and control handed over to the user, who was then in charge of controlling the PAV's heading. Speed and height continued to be controlled by the autopilot system. The HITS display from the DLR partners was used to provide navigation guidance to the user (see figure 3.3). A high level of augmentation[3] was provided during the whole flight making it easier for the user to control the PAV.

[3] an augmentation system changes the response of an aircraft so that its new dynamics are easier to control

The duration of the flight simulation was 11 minutes and the trajectory presented in the simulation was a flight from a suburban location around 15 miles southeast of Liverpool into the city centre. The flight route chosen replaced a car journey of approximately 1 hour on a route that is often affected by congestion in Liverpool.

Figure 3.1: Picture from the simulation: approach for landing in Liverpool city centre
source: Philip Perfect, UoL

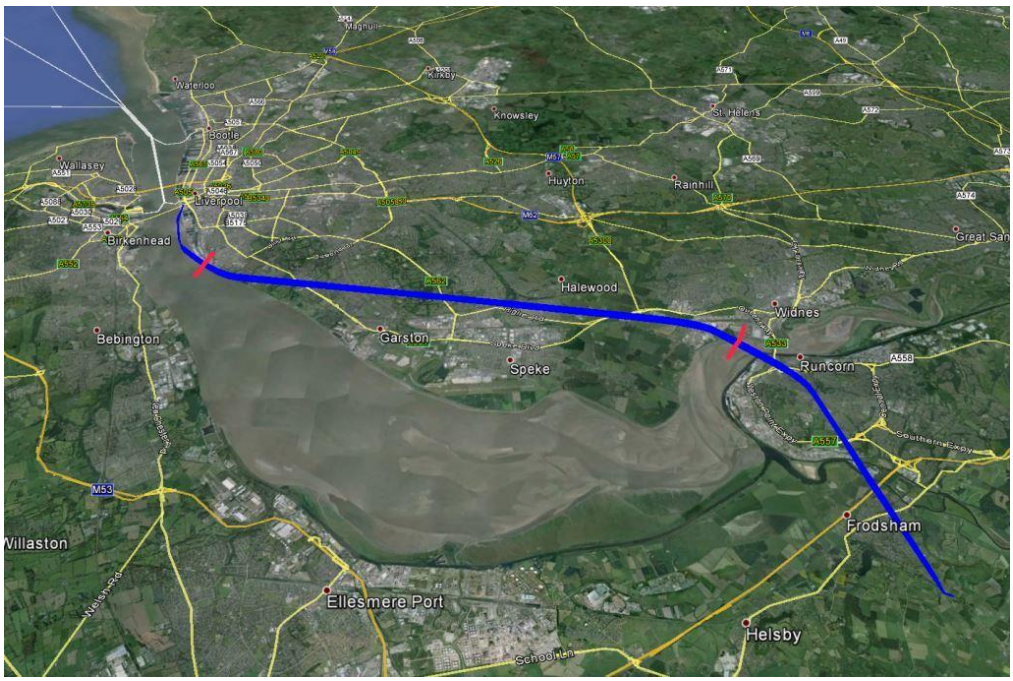

Figure 3.2: Course of PAV route (blue) during the flight demo, starting from a suburban location around 15 miles southeast of Liverpool into the city centre (Pier Head). Red marks show the transition from automatic to manual flight. Source: Google Maps

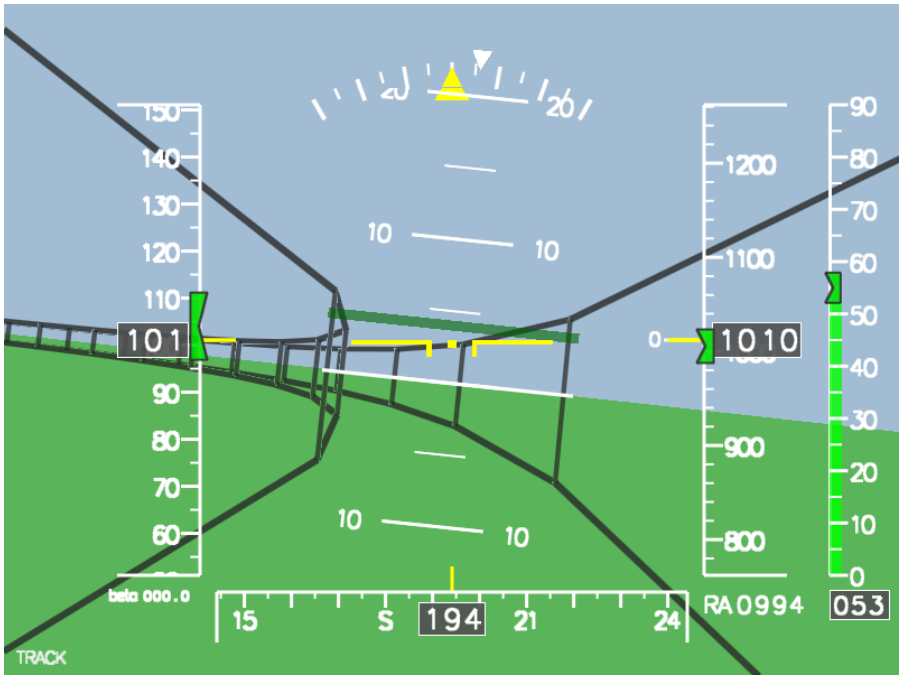

Figure 3.3: Picture of a highway in the sky display from DLR with tunnel gates indicating the suggested flight path.

Source: Gursky et al. 2014

The flight simulations in Tübingen and Liverpool were based on the same flight dynamics model and simulated a trip over the same scenery, but the two simulations were implemented differently because of the differences in the existing flight simulation facilities at the two locations.

Table 3: Comparison of flight simulation characteristics in Tübingen and Liverpool

	Tübingen	Liverpool
motion of vehicle	no	no
sound	no	generic helicopter sound
projection of outside world	yes, to a flat screen	yes, to inner surface of a dome
inside view	on screen mounted to fixed seat	on head-down screen mounted to cockpit frame with highway in the sky display

3.5 Analyses of Focus Groups

For a detailed analyses of the focus groups, they were audio recorded and later on transcribed, i.e. they were converted into written text.[4]

[4] For backup reasons two audio equipments were used for each focus group.

The person who was doing the transcription in Zurich attended the focus group event. This made it easier to follow the audio tape and to create a high quality transcript. In Tübingen this was not the case, but an experienced person who already did the transcription of the student focus group in 2012 was put in charge. In Liverpool, the person doing the transcription was also present during the event and followed the discussion.

The discussions were held in the respective regional languages and dialects. The transcripts of the Zurich (ZH) and Tübingen (TÜ) focus groups are in German, the one of the Liverpool (LV) group in English. Hence the quotes in chapter 4 are translations from German into English for the first two groups while the presented passages of the Liverpool group are excerpts from the original text. This should be noted since some connotations which could have been intended by the respective speakers by using a specific, sometimes regional, vocabulary might have got lost in translation.

The analysis of the transcripts was done inductively without prior assumptions about upcoming topics and statements. By working through the text, material categories were identified which combine major parts of the discussion. Finally, the material was condensed and assigned to the categories.

4 Results from the Focus Groups

In this chapter selected arguments and perceptions of the focus group participants are presented. In chapter 4.1 a summary of the first part of the focus group discussion about the current local situation during commuting and the general traffic situation in the cities is given. Chapter 4.2 provides an overview of the facts and characteristics of the PAV concept people wanted to know after being introduced to the PAV idea by the short narrative (see chapter 3.3). Due to this phase of clarification and fact finding people were able to build their own picture of the artefact PAV and develop their individual PATS scenarios. These images were then put into the personal life of the participants and their local environment. In doing this, facts and concerns regarding PAV use were connected with each other and led to new questions and the need for specifications. During this phase of clarification about the PAV vision also potential impacts of and concerns about the PAV technology were mentioned; these key issues and the discussions about them are presented in chapter 4.3.

4.1 Part I: Perception of Local Traffic Situation and Challenges

4.1.1 Tübingen

In this focus group nearly all participants had the perception that their city Tübingen has a traffic problem and that the situation could be much better, especially during rush hours (traffic jam on arterial roads). Frequently reported were problems with overcrowded busses, perceived high costs for car parking and urban transport tickets, as well as bad condition of streets in general. Problems in public transport to occur in winter were reported when due to snow some lines are not served anymore in the “hilly” area.

Regarding cycling it was mentioned that the marking of cycle lanes could be better visible and that the cyclists’ safety feeling was bad in narrow streets.

Generally the city was perceived as quite narrow regarding its street architecture and people found it difficult to imagine further ground traffic options, such as a discussed potential future tram line, on top of the existing traffic flow there.

4.1.2 Zurich

The situation in Zurich was experienced as quite uncomfortable for car drivers. Finding free parking sites was difficult, individual parking spaces were too narrow and parking fees were quite high. All of this is intended by local politics though and part of their “green politics”.

During rush hours a lot of traffic jams exist and the busses are overcrowded. At popular stations people sometimes have to await several busses before they are able to get on. Therefore people already try to avoid peak times, starting their work earlier/later. The impression of the participants was that the bus system has reached its capacity limit with some bus lines already operating at a four minutes pulse and the use of articulated busses. Another perceived problem were the frequent delays in public transport causing a lot of missed connections. People from outside the city centre often have to change several times and this was seen as uncomfortable.

The situation is intensified by diversions, construction sites und a lot of traffic lights, so driving a car in Zurich during the week was seen as very stressful and more an option for the weekend or people living outside the city where public transport was not as frequently available or not as suitable for the needed transport capacities (food) of big families. Therefore most participants living in the city did not own a car but all the people living outside.

The situation for cyclists was seen as suboptimal with bad routing (dead-end paths), too narrow paths and bad visibility of markings.

One topic which is not often expressed but might play a role more frequently is the issue of cleanliness in public transport. One lady described it as follows: “I don’t like using public transport so much because I find them quite disgusting. If someone has touched something with his hands and I don’t know who it was, I don’t like it and therefore prefer to take my bicycle”.

One general problem for Zurich was seen in the lack of housing and the high population growth. Therefore people would be forced to move outside into the suburbs which increases the need for commuting again.

A possible approach to improve and relieve the situation was seen in a better mix of living and work places, eventually coupled with home office and more flexible working hours. Suggestions for the actual transport systems were better instructions for the passengers in the buses and trams (not remaining at the doors and blocking the way for people boarding) as well as the use of more trailers during rush hours and the more frequent use of old double-deck rolling stock within the railway sector.

4.1.3 Liverpool

The car itself was seen as a quite convenient solution for the daily commute in Liverpool. Compared to public transport it is quite attractive in terms of costs and parking is often available for free. Nevertheless coming into the city in the morning rush hour is getting trickier and there are only three ways to cross the river. Regarding the bus system it was criticised that the buses to university get overcrowded in the morning and no electronic information is available at the stops about their actual arriving times.

Cycling in Liverpool was seen as a quite dangerous task with not many cycle lanes existing and the recent closing of bus lanes which were also been used by cyclists even decreasing this supply. Also conflicts between people bringing their children to school and parking on

cycle lanes forcing cyclists out into the traffic were reported. Therefore the request was to have more dedicated bike lanes, with visible painting and a safe width.

Improvement options regarding the bus line (which is the main public transport option in Liverpool) were seen in a re-introduction of separated but now continuous bus lanes, so that a real benefit against the normal road traffic was given. Also special school buses (probably operated by the schools itself) were mentioned and could relieve the capacity problems in the morning buses for students. Park & Ride was mentioned as a solution for people coming in by car, wanting to use trains or buses. Free parking is apparently already available at the stations but it is so coveted that the spaces are already completely full in the early morning.

4.2 Part IIa: Specification and Clarification Phase

In a first step of part II, participants were given time to familiarise themselves with the concept of flying vehicles for personal commuting. The idea was introduced by the moderator using a short narrative (see chapter 3.3) and by inviting the participants to spontaneously ask questions for further clarification of the idea, the concept and the transportation system vision in general.

After a short moment of surprise, most participants entered this “improvised Q&A game” and a very lively discussion developed. Questions in the first phase of this game focused on getting more detailed information about the characteristics and capabilities of PAVs themselves (like cost, size, propulsion technologies and so on) as well as on the design and structure of the PATS. For answers, the moderator presented details from the myCopter PAV design options study as discussed in deliverable 7.2.

Subsequently, also potential challenges and more critical perceptions were voiced by participants. The initial Q&A game gradually developed into a discussion among participants about their perceptions and justifications for the differences and the emerging plurality of positions. This more complex discussion was the key part of phase IIb and will be presented in chapter 4.3 of this report.

As a general observation from all three groups one might state that the first hour of phase II was mainly dedicated to clarification and the rest of the time for in-depth discussions. The topics that were touched upon in phase IIa were similar in all three groups, albeit they were mentioned in different sequences. If this is an indicator for different relevance of perceptions or just an outcome of the (arbitrary) group dynamics is still a matter of debate within the research team. For the purpose of this report, we have decided to summarize and cluster them in the mindmap presented below:

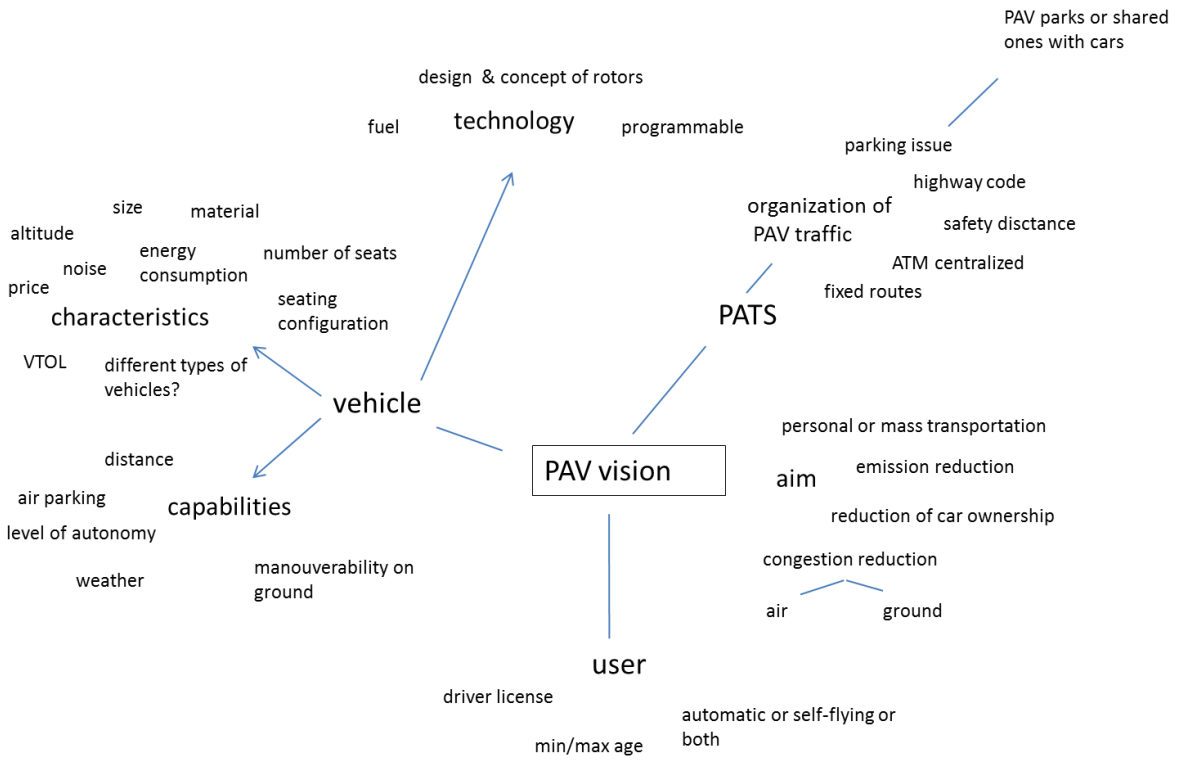

Figure 4.1: Collection of clarifying questions and additional information requests from the focus group participants regarding the PAV vision[5]

Source: own drawing

Some questions related to topics which are too complex to be easily transferred into a mindmap, which are not understandable without context or where the project consortium has not yet developed a position for are not included in the mindmap but briefly described below. So, for instance, it was asked whether the PAVs would be owned individually, whether they were part of a scheme that would be similar to car sharing or driverless taxi services or whether they would be operated only by a service provider with a “fixed” schedule. This is another aspect on top of the pure ownership question and would be a difference to a normal “car sharing” scheme.

Another question was about the allowed air space to be used and if it would be allowed to fly over private property of other people in low altitudes. If yes then the issue of privacy was identified and considered as problematic by most discussants.

Regarding safety it was asked whether a quantitative level of safety goal was existent (for example in terms of accidents per 100km or hours).

Another issue was whether the “normal” traffic on the ground would be still existent then? This was connected to the issue of finding parking space and the interaction with vehicles driving on the ground.

[5] It has to be noted that the use of mindmaps as a representation of content discussed in focus groups is not without problems since it decontextualizes topics and themes to a certain degree. We decided to use them nonetheless in order to provide a quick and concise overview of the various clarification questions people had regarding the PAV vision.

" but I already have the problem that I don't find free parking spaces, that is not solving the problem then …" (LV)

4.3 Part IIb: Perceived Problems & Challenges

As mentioned above, the second element of part II was dedicated to a broad and interactive discussion among participants about perceived advantages and challenges as well as about expectations linked to PAV and PATS. The discussion in all three groups took between 1.5 and 2 hours; it was very lively and dynamic but followed no strict thematic order. People started discussing topics that came into their minds, others joined and elaborated the ideas further or changed the subject. Hence, the discussion had to be restructured by the project team for a readable presentation so we decided to organize this chapter along topical clusters that we had identified during the analysis of the transcripts. A lot of the mentioned challenges could be summarized under the following categories: safety, environmental issues, infrastructure, ownership model, autonomy, system design & operational aspects, privacy & legal issues, as well as thoughts about user groups and areas of application. It is clear that some aspects could be assigned to more than one category and it should be noted that the order of presentation in this chapter is completely arbitrary, neither the chronological order of the discussion content in the focus groups nor the time spent on certain subjects allows for a valid prioritization of topics and/or clusters.

4.3.1 Safety

Safety issues mentioned by participants included both safety of users of PAVs ("on board") and people on the ground. Regarding on-board safety, misuse by terrorists, laser attacks, computer hacking into the system and danger through PAV parts dropping of one PAV down to another one were envisioned. Also the problem of induced fire due to a PAV crashing into buildings was raised. The problem of overhead lines (power, trams) that could prevent a secure landing in emergency cases and would be a handicap for PAV operations in cities generally was mentioned too. Also problems with aerodynamics during landing at places were buildings around could embrace the air flow were considered.

In terms of emergency cases, a distinction was made between an emergency situation for the person inside because of medical reasons and a system failure (loss of power, computer malfunction, etc.). An additional major challenge is surely the weather situation and how the PAV would be able to cope with strong winds, snow, icing and heavy rain. These problems were briefly mentioned by the participants but not further discussed because not much input could be given by the moderator because of the missing detailed design and further specifications of the PAV itself.

One safety problem, which is connected to the topic of standardization of the PAV's ability to communicate and sense its environment, are conflicts with other light aircrafts which are not belonging to the personal air transport system but are using the same air space.

The safety issue was interestingly coming up in all focus groups straight away at the beginning, expressed as a concern and then again right at the end. And here the focus had changed to potential solutions for an engine failure etc. with suggestions to have an airbag or parachute to handle system failures.

"But there must be something in that sort of system, that either the person has the parachute and if you're over the city you can't jump out. Where's he going to land over a city, but at least if you had a facility with airbags, whereas at the moment in a car the airbag protects you from the steering wheel and a crash

helmet, if you had some sort of airbags that came out the sides so it could still carry you somewhere, ***[unclear]*** *You've got to be able to get out of the danger zone. If you're in." (LV)*

Some participants also discussed the impact of PAV on people on the ground, both because of their (potential) ability to land everywhere or because of emergency situations.

"So in the future one has to teach children that they have to look not only to the right and to the left, but also upward." (TÜ)

"Would that then be a condition where we all walk around wearing helmets?" (ZH)

4.3.2 Environmental issues

In the category of environmental issues the energy consumption, power sources and energy storage for powering the PAV, noise and visual disturbances caused by swarms of PAVs were topics as well as the appearance of electric smog and maybe new health risks due to dispersed dust during take-off and landing.

A major issue was seen in the fact that PAVs would cause their negative effects like noise and visual disturbance everywhere and people would have no chance to escape.

"I think that [PAV traffic] would cause a noise carpet everywhere. Everywhere would be noisy. Now we have it close to streets, the railway and around the airport. But we still have oases with silence. But if we would have these flying objects then we have the noise everywhere." (LV)

In contrast to adverse effects by cars which are bound to visible infrastructure on the ground which could be avoided by living far away from major streets and so on this was seen as difficult to achieve with PAVs assuming that they could use most of the airspace.

"So before you … buzz around, just go underground, where nobody is disturbed. Because I will be really stressed, I don't want to see that thing as long as I live. Then just do something like the tube mail thing, below the surface with this flying objects, then it also will be really fast. I mean there is still a lot of nature outside and this will go to the dogs. I vehemently oppose this." (ZH)

"I also would not want it. On no account. Because to me, it would take away the view. On the lake, on the mountains, on the trees, all this. It is for me, actually, only about this view. The simple fact that they are exactly somewhere up there ... I would not want this, in no case. I would prefer to stand in the traffic jam, probably." (ZH)

"From below I have maybe, nevertheless, this idyllic image, I look into the blue sky, see a sunset or watch the clouds ((laughter)) ... and then I see nothing but points or whatever." (TÜ)

"But the idea that there are really thousands of these buzzing around and have their emissions, are noisy, produce shade and create crush, this disturbance, that's nothing I would need to have". (ZH)

To have an open, not obstructed view was seen as a valuable property in itself in Tübingen and Zurich. The idea to have PAV "streets" or routes above the lake of Zurich for example was seen as not acceptable and people there were very aware of and concerned about their surrounding landscape and the potential impact PAV/PATS might have on them.

Another aspect raised was the blocking of sunlight if PAVs in higher quantities would be flying around city centres.

> *"[…] because also, this is a bit of a different one, but if you've got all these planes or personal air vehicles flying over a city, is that going to block a lot of sunlight? Maybe not so much in England but abroad. But if you've got suddenly very quickly moving shadows all over the roads and you're driving and you're below them is that going to cause …" (LV)*

The overall associations people had regarding larger quantities of PAVs were quite negative, one person described it with the picture of having "aggressive wasps and bumblebees" flying around one's head. Another participant judged it as "absolute horror" and asked the question why she would have to deal with flying objects and all their (perceived) negative effects only because some people are "overloading" the traffic system. Especially the expected swarm traffic during rush hour was a major source of concern:

> *"I still have in my head, I sit there in the garden and suddenly such a cloud appears, the rush hour traffic. ((laughter)) If then really 300 or 400 of such cars fly over my house during rush hour, it is not only a small point anymore, but already a heap." (TÜ)*

PAV traffic was seen by many participants as more suitable for big cities like New York or Frankfurt where already a lot of background noise exists and the general setting fits better in terms of atmosphere and architecture (skyscrapers, the movie the Fifth Element was very much present in the minds of the participants).

As one potential solution to the visual disturbance problem created through hundreds of small vehicles flying around everywhere, one person brought in the example of Abu Dhabi. In its newly developed city quarter an electric monorail with clear routing and tracks will do a good job, create hardly any noise and will not disturb peoples view. The option to bundle and concentrate PAV traffic to certain "streets in the air" possibly connected to already existing major main traffic routes (highways) on the ground was seen as very reasonable and helpful for acceptance. At these routes already a lot of noise would exist and the recreation value would be minimal. Therefore additional traffic would not do as much harm.

> *"I also think it would be only possible if the biggest part of the airspace will be closed (for PAVs) … and only on certain routes, so on highways or above railway lines. It then would be simply difficult with the individuality, especially within cities. But, otherwise, I think it will not be accepted." (ZH)*

A kind of compromise for their own cities (Tübingen & Zurich) could be imagined if only certain days during the week or certain times of the day would be allowed for PAV operation (morning and afternoon rush hour times). Similar to a Chinese model where car use is only permitted on certain days of the week it was also discussed if every person would have one specific working day were he/she would be allowed to use the PAV. Quite common was the opinion that weekends should be PAV free and that this would increase and ease their acceptance.

> *"Probably excluding them from nature reserves or parks to preserve the tranquillity of those areas because that's the beneficial health effect of a small tranquil for the wildlife … Some sort of exclusion zones." (LV)*
>
> *"[…] on a street I can evade, I can search for regions a little more remote, can avoid streets. But if they fly everywhere above me, there is no place where I can feel safe and secure anymore. I cannot influence this risk and, therefore, I perceive it as higher." (ZH)*

As it becomes clear two main perspectives were present in the discussion. The one perspective was the user's one, being able to use a PAV and maybe even owning it. The other one was about the outside environment; this includes people on the ground, but also wildlife in the air and furthermore pets. For this second group the negative impacts, especially the noise and visual disturbance issue, were seen as dominating.

One participant was especially concerned of insects and their potential harm due to the rotors and the induced airflow. But also the more general reaction of wildlife and pets to PAVs were discussed and seen as critical. Collisions with birds and bats in the air seem to be unavoidable due to the high speed and altitude of operation of PAVs.

A frequently discussed question was if the PAV option would really improve the traffic situation on the ground or if every newly created mobility option and added capacity would not just lead to new traffic up to a point where everything – including the air space – would be overcrowded.

4.3.3 Infrastructure for PATS

Every transport option relies on its own specific infrastructure. Regarding PAVs it was thought about where these would be able to land ("even on the own balcony") and stored and if this would be partly possible together with cars or not (shared car parks). Also effects and implications on future architecture were discussed as this quote illustrates:

> *"I think it [PAVs] sounds like a brilliant idea and I'd love to use it, the issue I think that, particularly in England just due to the fact that the cities are built there's not the space to / I think basically you're going to have to have it you'd almost have to start again with cities. You'd have to build cities with huge docking stations in the middle, there's plenty of room in between buildings. I can't see it flying up and down the streets of Liverpool, how it would work there, but it's almost like you'd have to start building cities thinking about this now." (LV)*

Not only buildings but also pylons, telegraph wires and other objects not easy to detect for the PAV system and its sensors could need to be adapted to provide a safe operational environment for them.

Another quote which illustrates the thoughts about the integration into the existing car infrastructure and architecture of today's cities is this:

> *Participant: "What happens if I want to land with my PAV and there is something on the ground, for example a bin?"*
>
> *(laughter)*
>
> *"… this could be though"*

Moderator: "Yes, good point. Or a dog."

Participant: "Or a human is standing there and suddenly there is something coming from above and then it's just is over."

Moderator: "No, that has to be solved." (LV)

Another aspect belonging to the infrastructure complex is the issue of maintenance. The pre-checks from the commercial airliners are present in people's heads and also the fact that legally even before a car journey the driver is forced to do some checks. The need for pre-checks was not questioned but it was doubted whether the average user would be competent to do them. The service issue for PAVs was seen with a high amount of trained people needed to provide it associated with the question of costs and practicability (availability of PAV for operation).

"So what kind of level do these have to maintain because obviously when you use a car there's a set of checks you're supposed to do every time you get in, obviously I don't do them every time I get in my car and I don't think many people do, but if it's an aircraft the pre-flight checks are numerous and take a long time and your trying to instantly call something, someone's not going to be checking it each time it goes out I'm assuming but after each flight somebody needs to check it. Can they operate / say you've got a flight it gets particularly wet and does have a bird strike or something like that and it goes back, how do you check they are all continually working at safe operating?" (LV)

4.3.4 Sharing or Owning Pros & Cons

A lot of the discussion was connected with the question whether people would use the PAV in a kind of sharing scheme (even within a fixed schedule potentially) or if they would own it by themselves. This differentiation has a lot of consequences regarding infrastructure needs (parking space), maintenance & service issues, costs and availability.

"I think if I could press a button and it would appear, then the shared one would be fine, if you knew it was going to appear or if, I suppose if there weren't any it could tell you when you could have one, might be alright." (LV)

"I guess the shared one is going to have less cost than having your own. To belong to you it's kind of the cost argument." (LV)

"[..] in the sharing concept, if I want to go somewhere around 15 h, then at 15 h there has one to be here. So it would have to have a sufficient number of vehicles available, so that I have the opportunity at any time to use one. These are thousands of helicopters and in the morning they are all gone and all are sitting around at noon, so […]." (TÜ)

All these mentioned issues are strongly connected to the level of autonomy of the PAVs and their degree of autonomy. The full-autonomy option would be a basic requirement for the sharing scenario because in a 1-2 seater PAV a "taxi driver" who is piloting is not really an option.

4.3.5 Level of Autonomy

The possibility to have the PAVs operating in a full autonomous mode was seen as a good option to be able to provide door to door transportation and to ease the parking issue.

> *"Ah, so it would drop you off, when you get out you then tell it to go park itself." (LV)*

> *"Basically if you fly in, you land, get out by your building and then it flies off to a car park 5 minutes away. And then you call it as you're leaving the office, go down the elevator and in 5 minutes it's there waiting for you." (LV)*

In general people said that they would like and accept the full autonomy PAV version for the daily commute and flying in the city environment especially in dense traffic situations.

> *"When you're on your daily commute you sort of go into automatic pilot anyway. You don't really think about driving as such. You just get from A to B because you do it that often. I enjoy driving when I'm not going to work. So I like to go off, go somewhere and drive my car." (LV)*

The option to fly by oneself was seen as attractive for situations with less or no other traffic around, outside the city and/or in leisure time.

> *"That would be quite good couldn't it because if you were commuting as I said like a taxi almost you wouldn't be fussed about it but then say if it's the weekend, you want to go and have a bit of fun and that it would be quite cool to fly it. So I think maybe having so you could have fully automatic to just commute but then also the option to fly it to some degree yourself would be good." (LV)*

> *"So for me the "Coolness factor" would depend on whether one can do everything with it and it would be allowed to ride everywhere, without somebody saying: "Sorry, this is not permitted". But as soon as it is regulated and limited, then maybe I'll find it fascinating for some time or so, but then it would not be so cool for me anymore." (ZH)*

Regarding difficult flight tasks or emergency situations many participants were claiming that in these circumstances it must be possible to take over control.

> *„Even if it flies automatically. Yet alone because you need to be able to interfere. In my opinion. I don't trust this enough as that I could say it will fly me for 100% there. You have the experience from windows. There are system crashes, on every system possible. Well, you can have back-up systems, but just in case, it would be good to be able to take over manually." (LV)*

This would mean that a manual interface for piloting would be needed on the PAVs.

> *"Surely you only need an emergency manual system if it was fully automatic in case everything just blanked out, had a power cut, a failure or something, so you needed the manual system to try and at least get it down to the ground." (LV)*

This requirement of manual taking over if the system fails would also have consequences for either the design of a potential superior maybe central system which would be responsible then or would add to the user skills required to be allowed to use a PAV (training, license, etc.).

With regard to a perceived loss of control, the positions of participants were quite mixed. Many weighed the upsides and downsides of autonomous flying and piloting in various contexts and with different rationales:

> *"I believe the majority of the people would instead prefer to stand ten minutes in the traffic jam and to remain on the ground and to be Lord of the things. […] I think that the desire for security and down-to-earthness is far coined in the society. This may be different in hundred years, but from the current perspective the ability to control something by yourself is also a quality which a person does not want to get rid of. And experiences with automatically steered cars also show that it is very unusual for people to pass the control stick." (TÜ)*

> *"I'd prefer fully automatic. […] Because I wouldn't trust anybody else. […] I trust the technology, I would trust the technology, I just wouldn't trust the other people in the vehicles and there's just too much at stake if there was an accident. So you say you're building into the system some sort of automatic collision avoidance and all the rest of it you've still got all these vehicles doing all this in front of you because some boy racers decided to fly around between all the buildings in the city. I'm not saying it wouldn't be fun, because it would be fun." (LV)*

> *"So there's this chap there who's decided to hire one, go off and fly around, overstress the airframe, comes to me and I get in it, the wing drops off… And that's why I think it should be automatic, fully automated." (LV)*

> *"If it is automatically steered, one hands over control (to the PAV) – and if one can steer himself, I see too many dangers. So if really every Tom, Dick and Harry may manoeuvre in the airspace and, however, sometimes doze off because they have had the mega party ... there someone can really cause damage if he is allowed to steer. One the other hand, if one simply can get on, drunk, and will be driven home like in a taxi, this would be great." (TÜ)*

4.3.6 Legal Issues

One question coming up in every focus group was the one after the responsibility in case of an accident in the autonomous mode.

> *"If there's it's all automatic and for whatever reason an accident happened two collide or collides with something else whose fault is it?... If it's automatic you're not got / driving it as such a better phrase then, if something does happen who's responsible?" (LV)*

Another challenge which relates to authorities and the legal framework was about standards regarding the communication system of the PAVs (between each other but also with other flying vehicles) and the batteries. For the batteries an exchange system to minimize waiting times and allow for greater distances or broader timeframes of availability in a sharing model were called for and a problem was seen in the fact that different companies would bring different standards onto the market.

4.3.7 Other Areas of Application & Travel Purposes

Asked for what else a PAV could be useful the participants mentioned the field of tourism (flying over Paris, trip into the mountains), the option to use them in the real estate business

(flying over properties), archaeology and for the provision of emergency medical aid for rural areas. Applications in the environmental sector such as forest monitoring were also mentioned but not seen as so promising because drones are already quite successfully operating here. Similar to journey to work traffic the school children were seen as a potential user group.

Additionally in the medical sector it was seen as useful to be able to bring the first aider with the PAV quickly to the place of need and then have normal ground transportation to transport the sick person into hospital.

Asked whether PAVs would be suitable for older people, there were ambivalent answers. This age group often has no flight experience and would probably be afraid of using a PAV. Their reason for traveling would also often be to get social contacts (small talk in the bus) and this would be missing. The acceptance of older people of the full-autonomous mode was questioned.

5 Outlook

In summary it can be said that all three focus group discussions were very lively and insightful. The participants brought in a lot of personal opinions, comments and valuable criticism regarding the PAV concepts and future PATS. They also made a number of suggestions regarding future design options and operational models for both personal air vehicles and transportation systems accommodating them.

It was interesting to see how people switched between two perspectives – that of the potential user who sees attractive new transportation options and that more outside perspective of residents or people on the street who might be affected by the potential impacts of PAVs. They tried to picture how PAV traffic would look like in their city and everyday life, in their garden, from their flat, etc., but the personal perspective from “inside the PAV” was imagined in detail as well.

It is impossible to draw a single, generalized conclusion from our observations. The picture is rather mixed in various ways. First of all, it should be noted that the focus groups were exploratory and thematically rather broad. They were designed to provide first insights into a broad set of perceptions and concerns rather that a detailed discussion of pros and cons linked to single issues. Hence, the analysis names a number of potentially controversial subjects, but does not investigate them in greater depth. This has to be done in future focus groups with a more detailed PAV/PATS design.

Second, a number of ambivalences and ambiguities were identified that should be subject of further research. So, for instance, most participants did not express clear preferences with regard to fully automated PAV or those that allowed for self-piloting. There appears to be a tendency that people favour automated flying in certain circumstances (like routinized ways or high traffic densities) and the opportunity of self-piloting in others (leisure travel, low traffic density, sports). Another example regards ownership models: While some participants preferred to have their own PAV (for various practical reasons), others very much liked the idea of the “PAV on demand”. A third example is linked to the broader “loss of control” debate – some participants argued that handing over control to the PAV is perceived as a loss, other participants said that they perceive it as an actual gain since they trust the control technology mid-air much more than individual persons with unknown piloting abilities.

Thirdly, future focus groups could – and perhaps should – be linked to more realistic simulations of a PATS including real-life traffic situations. We tried to follow this approach by including flight simulation experiments in Tübingen and Liverpool which were used as an

additional stimulus for the focus groups in both cities. Although experiences with these simulations were discussed with the participants, they were not further analysed and presented in this deliverable but will be discussed with the internal partners first. What can be said at this point in time is that these simulations could only give a first taste of how a PAV ride could look like in the future and more effort would be needed to be put into the simulations to make them complex (other PAV traffic present in the sky for example) and realistic enough to be convincing for the participants.

Although most issues discussed in the focus groups were already on the agenda of the project team and included in the screening report (Del. 7.1), a number of further and deeper insights could be won. It was, e.g., surprising for the project team, that many participants very much highlighted the relevance of some issues such as the visual disturbances caused by a large number of PAVs and also questions of detail were added to the research agenda.

The key issues discussed and the perspective people expressed will serve as a valuable extension of the screening report (Del. 7.1) and will be used for the development of the final scenarios in Task 7.4.

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