White Paper

Mind the Gap: Concepts & Pathways for a Societally Acceptable Future of UAS in Europe

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ABSTRACT

UAS have the potential to profoundly change our everyday life. A constantly growing catalogue of applications may soon make them more visible and 'tangible' to wider parts of the society. However, while drone technology is continuously advancing and a regulatory framework has already been put in place, public perception of the issue is still in its infancy. This evolving gap subsequently introduces a critical degree of uncertainty and poses a risk to industry and policy makers alike. Our contribution will shed light on the complex mechanisms of societal acceptance. Adopting key concepts from technology acceptance research to the specifics of the UAS environment, we will illustrate the subject's key factors comprising perceived risks, controllability and benefits (Chamata & Winterton 2018). Based on an extensive literature analysis in the field of urban drone delivery and passenger transportation, we will then discuss proposed solutions that can moderate the role of risk perception in the technological innovation process. Aiming for a transfer from sociotechnical theory to industrial and planning practices, we will provide recommendations for public-oriented design and implementation strategies based on the approaches of openness, transparency and participation. As technology matures, the paper advocates for paying closer attention to issues of societal acceptance that may form a future task of the European UAS community because without doing so, economic scenarios and the legitimacy of an institutionalized framework stays at risk (Lucke 1995).

CONCEPTS & PATHWAYS FOR A SOCIETALLY ACCEPTABLE FUTURE OF UAS IN EUROPE

1. Introduction

While the commercial use of UAS in Europe currently is not yet a major issue in public discourse, a constantly growing catalogue of potential UAS applications may soon make them more visible and 'tangible' to wider parts of the society. A common vision by key stakeholders is the operational integration of drones into lower airspace by 2023 (SESAR 2018).

When we speak about any such scenarios, consequences for society have to be taken into consideration. Sooner or later the question of societal acceptance for drone technology will arise, especially since it is often argued that those who will be most affected by their deployment in daily life are typically not the ones who make the decisions about their deployment (Lidynia et al. 2018; Clothier et al. 2015). This contains a potential for conflicts.

In contrast to technological advances and the regulatory framework, evidence on how to negotiate societal acceptance regarding a broad deployment of UAS remains scant. Disregarding this evolving gap introduces a critical degree of uncertainty and poses a risk to the industry and policy makers alike, as the public may oppose the envisioned market integration.

This white paper aims to sensitise a predominantly application-oriented readership to the significance of the topic. It also presents concrete approaches for key stakeholders on how to integrate public concerns into the current technological and regulatory innovation process.

2. Background

This white paper forms a part of the public research project *'The Sky is the Limit',* funded by the German Federal Ministry of Education in the scheme of Innovation and Technology Analysis. The research contributes to an inclusive and comprehensive technology assessment, focussing on potential risks and benefits of urban cargo and passenger transportation by drones. We follow a holistic approach combining secondary research, public opinion research and multiple formats of participatory dialogue. Research results will be synthesised into policy recommendation, aiming to moderate negative consequences of the technology.

3. Method

As part of our secondary research, we conducted a substantiated literature analysis of 111 publications published between 2013 and March 2019. These included papers by academics, private and civil sector as well as by advisory and legal institutions of the European Union's (EU) legislative body. While most publications concentrate on the topic of drone logistics (19%), attitude and acceptance research forms another relevant body of literature (13%). Papers were analysed according to our research focus and the relevant number of 2615 identified quotations were grouped within four categories:

- Expected Benefits related to drone use (15%, 381)
- Problematisations regarding their deployment (40%, 1037)
- Barriers to implementation (16%, 426)
- Proposed Solutions, relating either to problematisations or barriers (29%, 738)

4. Relevance of Societal Acceptance

In the literature analysis, quotations about societal acceptance relate to either implementation barriers or proposed solutions.

4.1 Societal Acceptance as a Barrier

Quotations about acceptance as an implementation barrier make up the third largest topic (16%, 67) and are thus acknowledged in the literature as a relevant enabler or disabler of drone technology.

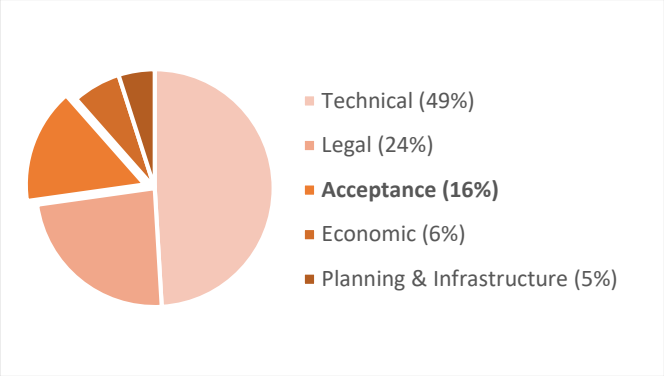

Figure 1: Overviews Barriers

Noticeably, for quotations regarding societal acceptance, we see a steady increase in numbers from 2015 onwards, indicating a general increase in attention. Analysed by authorship, we see that authors from the private sector acknowledge acceptance as a barrier relatively frequently.

The majority of quotations rather generally speaks about the importance of societal acceptance (43.3%), while some authors explicitly point to the relevance of mediating factors such as privacy and data protection (25.4%), safety (17.9%) and noise (9%).

4.2 Proposed Solutions on Societal Acceptance

In the category of proposed solutions, quotations regarding societal acceptance are similarly common (14%, 103).

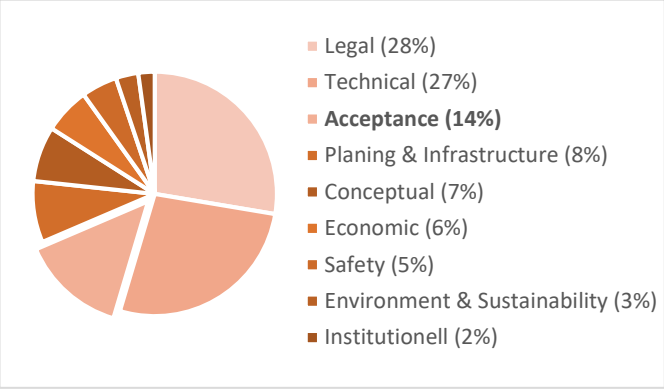

Figure 2: Overview Proposed Solutions

Academic papers propose several approaches towards societal acceptance while private sector papers largely neglect that aspect, indicating there is no visible acceptance strategy in the private sector.

In the documents analysed, increasing *information and transparency* (35%, 36) is the most frequently proposed solution strategy. Here, information and transparency is not just broadly understood as a catalyst for public discourse but also as a precondition for the (legal) empowerment of citizens.

Secondly, various concepts for *'good' regulation* are introduced in the papers, with a tendency to favour those regulations which address public concerns (19.4%, 20).

Yet another approach towards achieving societal acceptance is the proposal of *technical and design solutions* (14.7%, 15). More operational safety, privacy by design, accountability through equipping drones with chips or designing them in a more quiet and environmentally friendly way are among the most commonly mentioned solutions.

Dialogical and participatory approaches are proposed as a solution in 12% (12) of the quotations. Given that drone technology will soon be commercially operational, it is argued that *"it would be high time to open up a debate now"* (Nentwich & Horváth 2018).

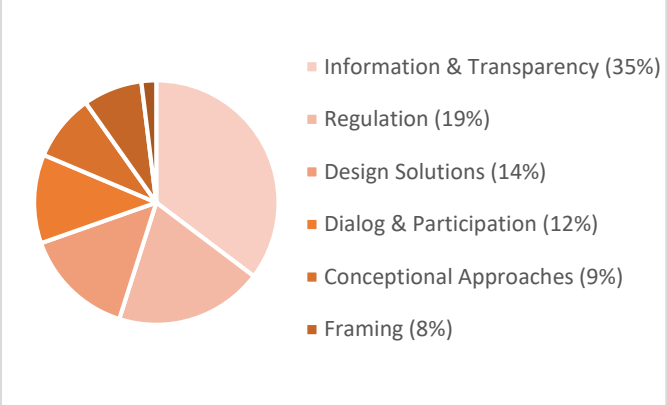

Figure 3: Proposed Solutions on Societal Acceptance

5. Technology Acceptance Research

From a theoretical standpoint, it is important to understand that acceptance emanates from a subject's attitude towards an object with both subject and object placed in a contextual setting (Hüsing et al. 2002). Factors influencing societal acceptance can be found within this basic conceptual framework.

Qualitative and quantitative research is used to explore relevant determinants. However, it is generally agreed that research on scenarios of urban drone deployment is still lacking (among others: Nelson et al. 2019; Chamata & Winterton 2018; Otto et al. 2018).

The *acceptance subject* may be an individual, however, in terms of technology assessment the focus is usually on groups (e.g. persons concerned of drones, potential customers, citizen) or on society as a whole. For acceptance research, those factors are relevant that determine the subject's attitude. In other words, one wants to know what is important for the subject when forming an opinion. The subject's values, wishes or former experiences may be influential, too.

The *acceptance object* can be very diverse as the introduction of a technology has many dimensions. Technological acceptance research asks about the characteristics of the object and the consequences emanating from these characteristics that are of interest for the subject. Moreover, the acceptance object may also be a legal decision or a planning procedure related to the topic. Topics of controversy may be drones themselves, their characteristics and capabilities.

As *acceptance context* one considers moderating effects like overarching cultural values or the current political situation. Furthermore, the way in which a technology is introduced to the public (process design) can be a contextual factor that strongly influences how attitudes are formed.

Due to the design orientation of technology acceptance research, the exploration of relevant factors is important. What is further needed are acceptance models that structure these factors. They also need to be explanatory regarding the direction of the effect.

While specific acceptance models can be found in the literature, Johnny Chamata and Jonathan Winterton (2018) are pioneers in the sense that they were the first to apply such a model to the specific context of drone use. Here, in essence, the attitude towards drones results from the interplay between:

- *benefits* the technology is perceived to bring,
- *risks* associated with it,
- perceived *controllability* of the technology.

Against this background, any approach intended to increase the likeliness of public acceptance should aim to increase those benefits relevant for the public, minimize the prevailing risks and make sure the control over drones as well as the authority over their deployment stays in the hands of those who are entrusted by the public (Hüsing et al. 2002).

4 Discussion

This short introduction may facilitate the discussion of recommendations for public-oriented design and implementation strategies. Therefore, we will look at the four most dominantly proposed solutions we identified in our literature analysis.

4.1 Information & Transparency

Information and knowledge should be a prerequisite for the acceptance *subject* to form an attitude. However, what becomes obvious in most papers in the field of acceptance research or just by talking to people in everyday life, knowledge about possible benefits, about risks and about current political developments in the context of drone use at present seems rather limited.

The public needs information to form an attitude based on other factors than mere 'feelings' towards drones as a technical object. However, transparency also has a *contextual* dimension. Scepticism and maybe suspicion towards the current legal, technical and economic development must be avoided. Civil organizations and interested individuals, lower administrations and municipalities should not be bypassed nor be surprised and overwhelmed by future developments.

For the drone community to remain entrusted with the implementation process, active information of other stakeholders is needed. What is more, while comprehensive information may serve to increase public acceptance, a widespread impression that information is provided selectively to the public could work against it. So to say, one should speak about the humanitarian benefits of drones, but one should not conceal, for example surveillance and privacy issues or controversial military synergies (see: Boucher 2015).

Approach: Comprehensive information and visualizations about the functionality and application possibilities of drones; about expected positive and negative effects of the technology; about the planned use of the technology as well as transparency about the planned implementation process (including opportunities for participation).
Stakeholder: Higher administration, especially for those points regarding process information; research institutions but also the broad UAS community for drone specific information.

4.2 Regulation

Regulation should always be a fair balance of interests. Regulation as a proposed solution for public acceptance implies first and foremost that those interests of most importance to the public are safeguarded by the law. Given that, regulation will positively shape the *context* of drone deployment.

As the European Commission's regulations addresses for example concerns regarding privacy, safety and noise of drone technology, it moderates factors, which we also identified as barriers in the literature research. However, the greatest challenge at present is the implementation of EU regulation into national law. What is more, future

developments may lead towards new regulations on state and municipal level.

Then again, societal acceptance promoted by a 'good' regulation must ensure that the use of drone technology is not disruptive towards the prevailing norms and values of the people concerned by those laws. For instance, growing demands for increased sustainability or participatory rights may gain importance in national or urban context. Good regulation as a proposed solution for public acceptance then means that these values are safeguarded within the legal framework for the deployment of drones.

Advice: Conducting further research as well as public consultations in support of the identification of relevant factors that need to be safeguarded by law.
Stakeholders: regulatory body & advisory boards, social research institutions

4.3 Co-Design

Another approach to create broader acceptance of a technology is to minimize societally unwanted implications of the *object*. Therefore, proposed solutions in this category focus on UAS, their capabilities & functioning.

Companies may apply this strategy already to reflect their customers' wishes. However, Co-Design as an approach for societal acceptance needs to incorporate not just customer values but most importantly public expectations regarding the product. Common for formats of participatory design (PD) is the direct involvement of all stakeholders in the design process. Most common Co-Design formats comprise *Co-Creation Workshops, Hacker Spaces* or *Citizen Science Formats.*

For technology development related to drones this implies the inclusion of the general public, in order to get a comprehensive understanding of public concerns regarding the technology in general and the product in particular. While such a Co-Design process increases workload, conducting this process can be highly beneficial for companies as it:

- provides certainty towards the product development
- improves the external perception of the company
- fosters customer bonds and community involvement.

What is more, in consequence companies will promote better technologies to an informed public with more realistic expectations about the objects.

Advice: professional exercising of acceptance-by-design strategies.
Stakeholders: Co-creation processes can really be a chance for hardware (components) as well as software development companies and operators.

4.4 Dialogue & Participation

Approaches using formats of dialogue & participation aim to improve the acceptance *context* in a way that they provide an empowering framework for concerned subjects (Huijts et al. 2012). That is of major importance as many consequences of a broad drone deployment in urban airspace have to be borne by others than the ones who decide upon their deployment and economic exploitation.

It remains to be seen on what concrete issues participatory processes can be effective in promoting acceptance. At present, suitable topics seem to be U-Space planning or the development of urban action plans and draft legislation to structure a drone deployment along citizen's expectations.

Despite the object that is to be discussed, the process quality is of huge importance. In other words, if the discussion will be a sham offer for participation stakeholders will lose the trust of the people or organisations addressed with these formats. This would decrease public perception of controllability and increase the perceived risk.

The question of what is a 'good' and therefore an acceptance promoting participation process is discussed extensively in the literature. To just name a few of the most common ideas:

- involvement of all groups of actors that are affected by a decision;
- early involvement possibilities where options are still debateable;
- a fair process which implies that there really is openness towards the results;
- a transparent process which means there are clear objectives for the process, binding decision-making structures, binding statements on the planned use of the results;
- a continuous dissemination of information.

A successful participatory process can potentially have further positive effects. First, stakeholders should have increased their knowledge to better assess the triangulation of risk, control and benefits of the relevant object. Second, the legitimacy of the planned object can increase as participants' knowledge increased the overall quality of the planning.

Advice: Proactive identification of opportunities for and support of participatory formats in the development process.
Responsibility: Administrations, municipalities, academia.

5 Summary

This white paper aimed to sensitise its readers to societal acceptance as an increasingly important factor for the future of urban drone deployment. However, strategies on the issue remain unequalled in comparison to the actual technical and legal development. That gap poses uncertainty and risk to the industry and policy makers.

In order to overcome this gap, technology-orientated acceptance research is of increasing importance. Its task is to identify factors that are relevant for the public attitude towards drone deployment. Open minded social research but also a variety of participatory processes support this to get a clearer picture.

For now, key measures are: comprehensive and transparent information about the technology & the planned implementation process; a regulation orientated towards the public interests; increased product quality by co-design; as well as the utilisation of participatory formats in the development process.

About the Authors

Tobias Biehle is research associate in the exploratory research project Sky Limits, which examines the possible development and future use of urban airspace by (logistic) drones. Due to his previous work in the commercial dialog moderation and his participation in the Center for Interdisciplinary Risk and Innovation Research (ZIRIUS) his professional interest further focuses on the field of urban mobility, urban planning and participation processes. He is holding a degree as Bachelor of Arts, Sociology from the University of Bremen as well as a Master of Science, Planning and Participation from the University of Stuttgart, Germany.

Robin Kellermann is research associate and project coordinator of Sky Limits at Technical University Berlin. Holding a degree in cultural and historical urban studies, his main research areas are mobility and transport with a special focus on user-experiences and transitional aspects of moving towards a future of post-fossil mobility.

Cited Literature

Boucher, P., 2015. Domesticating the Drone: The Demilitarisation of Unmanned Aircraft for Civil Markets. Science and Engineering Ethics 21, 1393–1412. https://doi.org/10.1007/s11948-014-9603-3

Chamata, J., Winterton, J., 2018. A Conceptual Framework for the Acceptance of Drones. The International Technology Management Review 7, 34. https://doi.org/10.2991/itmr.7.1.4

Clothier, R.A., Greer, D.A., Greer, D.G., Mehta, A.M., 2015. Risk Perception and the Public Acceptance of Drones: Risk Perception and the Public Acceptance of Drones. Risk Analysis 35, 1167–1183. https://doi.org/10.1111/risa.12330

Huijts, N. M. A., E. J. E. Molin & L. Steg. 2012. Psychological factors influencing sustainable energy technology acceptance: A review based comprehensive framework. In: Renewable and Sustainable Energy Reviews 16/2012, Page(s): 525–531.

Hüsing, Bärbel, Rainer Bierhals, Bernhard Bührlen, Michael Friedewald, Simone Kimpeler, Klaus Menrad, Jürgen Wengel, René Zimmer & Peter Zoche. 2002. Technikakzeptanz und Nachfragemuster als Standortvorteil. Abschlussbericht. Fraunhofer-Institut für Systemtechnik und Innovationsforschung (Frauenhofer ISI). Karlsruhe. Page(s): 24.

Lidynia, C., Philipsen, R., Ziefle, M., 2018. The Sky's (Not) the Limit - Influence of Expertise and Privacy Disposition on the Use of Multicopters, in: Chen, J. (Ed.), Advances in Human Factors in Robots and Unmanned Systems. Springer International Publishing, Cham, pp. 270–281. https://doi.org/10.1007/978-3-319-60384-1_26

Lucke, Doris. 1995. Akzeptanz. Legitimität in der „Abstimmungsgesellschaft". Leske + Budrich: Opladen.

Nelson, J.R., Grubesic, T.H., Wallace, D., Chamberlain, A.W., 2019. The View from Above: A Survey of the Public's Perception of Unmanned Aerial Vehicles and Privacy. Journal of Urban Technology 26, 83–105. https://doi.org/10.1080/10630732.2018.1551106

Nentwich, M., Horváth, D.M., 2018a. Delivery drones from a technology assessment perspective. Institute for Technology Assessement Vienna (ITA).

Otto, A., Agatz, N., Campbell, J., Golden, B., Pesch, E., 2018. Optimization approaches for civil applications of unmanned aerial vehicles (UAVs) or aerial drones: A survey. Networks 72, 411–458. https://doi.org/10.1002/net.21818

SESAR Joint Undertaking, 2018. European ATM Master Plan – Roadmap for the Safe Integration of Drones into all Classes of Airspace