CHALLENGES IN MOBILITY RESEARCH

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Content

Why:
Explanation why this research is relevant now

How:
Research set-up
Network / research sources

What/result:
List/mapping of Public Private Projects
Status Quo/ conclusions
Next steps and research questions for the future
Relevant links (to white papers or other documents)

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Why this research?

CLICKNL, Design United, the World Design Embassies, & the Dutch Design Foundation have a shared interest to make an inventory of projects where private & parties collaborate. Based on this inventory they want to learn about the current state of the art on knowledge & research projects to find knowledge gaps. These knowledge gaps will be the input for the development of the research agenda for (KIA) for CLICKNL.

This inventory is made for the six themes in of the World Design Embassies: Mobility, Circular & biobased building, Water, Security and Health.
This document describes the insights for Mobility Research.

Within the KIA there are four mission themes of which the Energy transition & Sustainability theme contains aims related to mobility. It aims for emission-free mobility for people & freight in 2050. The insights and projects described in this document relate to this aim.

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Research set-up

In order to get a grip on the challenges around the complexity of mobility we've interviewed several people (see next page), visited (online) events related to mobility hubs and read documents provided by the project representatives and found by ourselves (literature).

We focused on the topics interviewed people where working on, their opinions of the future of mobility, and the topics that may be relevant for the future as well.

We mapped all the insights in Miro and clustered the insights in five groups of projects, called themes. In this document we describe the research in the themes and also describe what directions we see for the future based on the insights we gathered.

Good to mention, is that we started with the focus on mobility hubs, but based on the insights and opinions on mobility hubs broadened the scope into complexity in mobility.

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Research set-up: sources

Design United:
Delft University of Technology
- Sicco Santema
- Suzanne Hiemstra
- Mignon van de Berg
- Sasha Hoogendoorn
- Matthijs van Dijk

University of Technology Eindhoven
- Carlo de Weijer
- Marieke Martens
- Soora Rasouli

University of Twente
- Mascha van der Voort

World Design Embassy of Mobility
- Marijn van der Poll

Universities of Applied Sciences
- Walther Ploos van Amstel (HvA) (Hub Congres)
- Jos van Dam (InHolland)

Other Organisations
- Nick Juffermans (Goudappel Coffeng, Hub congres)
- Bas Bongers (I&W) (Hub congres)
- Shyreen Shaib (I&W) (Hub congres)
- Ton Verhoeven (Hub congres)
- Lotte Dietz (VanWaarde)
- Liesbeth Couwenberg (P2)
- Marco Gerrese (Schiphol)
- Joost van der Made (NS)
- Tim Daniels (Brainport Development)

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STATUS QUO: Mobility Research Themes

The research and projects, described by the researchers and practitioners, are categorised in five overarching themes:

- **Mobility of people**: mobility for the (individual) passenger, his/her needs, and journey
- **Mobility system**: the mobility system with all its components and interaction between modalities
- **Context of mobility**: contextual themes that effect mobility
- **Mobility designer**: the designer in the broadest sense designing mobility systems
- **Researcher/teacher in mobility**: the researcher doing research in future mobility.

The content of each of these themes is described in the following pages. Each theme ends with possible future research questions regarding the topic described.

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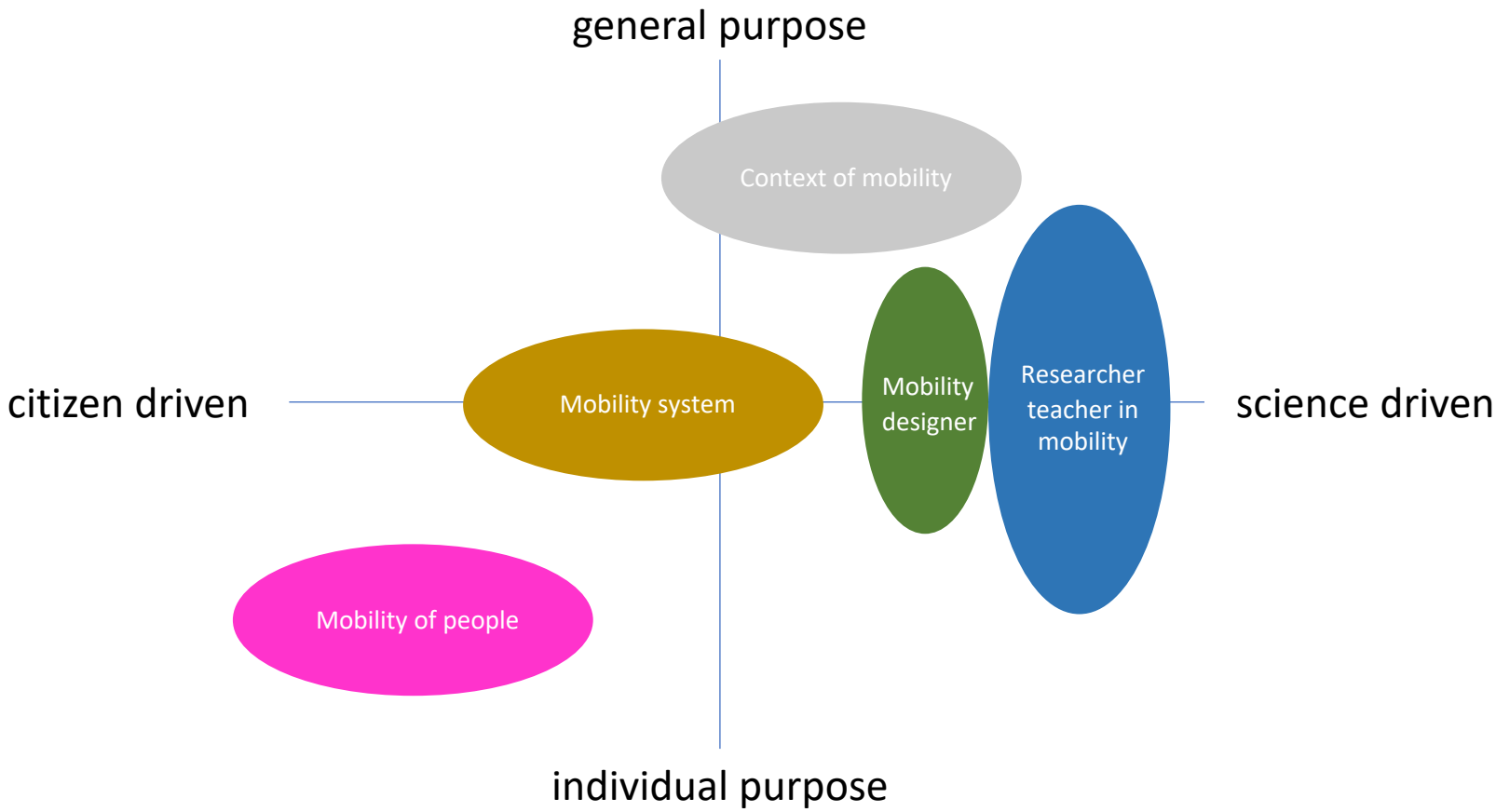
STATUS QUO : Mapping of Mobility Research Themes



Framework for mobility research topics.
Based on the Framework that was introduced at European Citizen Science Association Conference, (Sept. 2020) and used in interactive session, 12 Nov. 2020.

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Mobility of people

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Mobility of people (1/4): Passenger centricity

Related to the people there are several topics researchers and practitioners are working on that also raise future questions.

Passenger centric: the passenger is the central individual in the system and one should design for those individuals. Mobility is seen as a means and not a goal in itself where one should look at the goal of mobility. It was also more often mentioned that one should look at the whole journey including all modalities.

Looking at the individual one should be aware of the *inclusivity* of the solutions we create and whether one also includes low literate passengers and/or are accessible for digitally low literate passengers. There are all sorts of reasons people can't or won't use digital solutions as research shows.

→ How to design services/systems for all users?

By designing for the passenger one designs for high comfort, a better *passenger experience*, assuring the passenger is taking care of and unburden during his travel at all stages in the journey. The passenger, for example, doesn't have to search for a parking spot for his car or bike. At the same time passengers want self control and don't want to put their fate in the hands of others or public transport.

→ How to design services with high comfort, that unburdens users, and assure self control?

Pure Skies Embassy of Mobility

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Mobility of people (2/4): Driving autonomous vehicles

In the research to autonomous vehicles research is done into the *interaction between the user and the vehicle*. Researchers work on topics like the balance between what an user does and what the vehicle does, and what a valuable role for the user may be. This also includes other valuable activities a user can do while driving in a car. They are also working on what to measure in the car and what we want to measure, do we for example want to measure the user fatigue, the users attention, other activities he/she does, etc. Researchers also work on topics of trust and creating a comfortable feeling in the vehicle. At last topics research is done into remote operators of the vehicle. Autonomous vehicles can only be successful when adopted by the public. This raises questions on how to create the adoption.

- → How to design the interaction between user and autonomous vehicle and what's a valuable role for the user?
- → How to keep the drivers attention (autonomous vehicle)?
- → How to create the trust matching the vehicle?
- → What are additional services/activities in an autonomous vehicle?
- → What is needed for the adoption of autonomous vehicles?

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Mobility of people (3/4): Multimodality

When focusing on the whole journey researchers look into the whole journey and how to connect all modalities into a *seamless passenger journey*. In doing so the first and last mile should be included and organised. It appears difficult to connect all modalities. By offering all modalities one should offer personalised services to the passenger where he/she had the opportunity to choose the modality of his/her preference.

→ How to design seamless personalised services including all modalities?

When designing the multimodality for passengers ideally the passenger wouldn't mind to wait for another modality, or missing a bus wouldn't matter. This means one should offer relevant services to assure he/she enjoys oneself. This could also mean that these *additional services* should be part of mobility applications. For example where assets for working from home will be part of a mobility phone application.

→ What are additional services/activities at hubs?

Other solutions explored are *demand responsive* services, so instead of ensuring one could enjoy oneself, the services are offered just in time or in a high frequency. This could be for public transport, but also for, for example, traffic lights for cyclers.

→ How to design demand responsive services?

Laura van Overhagen with Suzanne Hiemstra, TU Delft, A design vision towards seamless European train journeys: Making the train the default option to travel in Europe

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Mobility of people (4/4): Multimodality

In researching interactive *multi-decision models* to possible steer the choices of users, more and more variables are preferably included. Not only personal preferences, but also one mood or earlier experiences on alternatives can influence people's preference. While offering the user alternatives, they shouldn't be overloaded with options and have the freedom to select their preference. These models should also offer realtime information and be trustworthy for the user.

→ How to include mood, experience, preferences in interactive multi-decision models?

When offering multimodality to users, at some points one would want to steer behaviour of passenger into other modalities or other travel times, because of sustainable reasons or available capacity. The requires *behavioural change* and raises questions on how to achieve that.

→ How to create behaviour change to sustainable or other modalities?

Rosa Hendrix with Suzanne Hiemstra, TU Delft, A service design vision for air-rail journeys: Stimulating travellers to make a more sustainable choice for their journey

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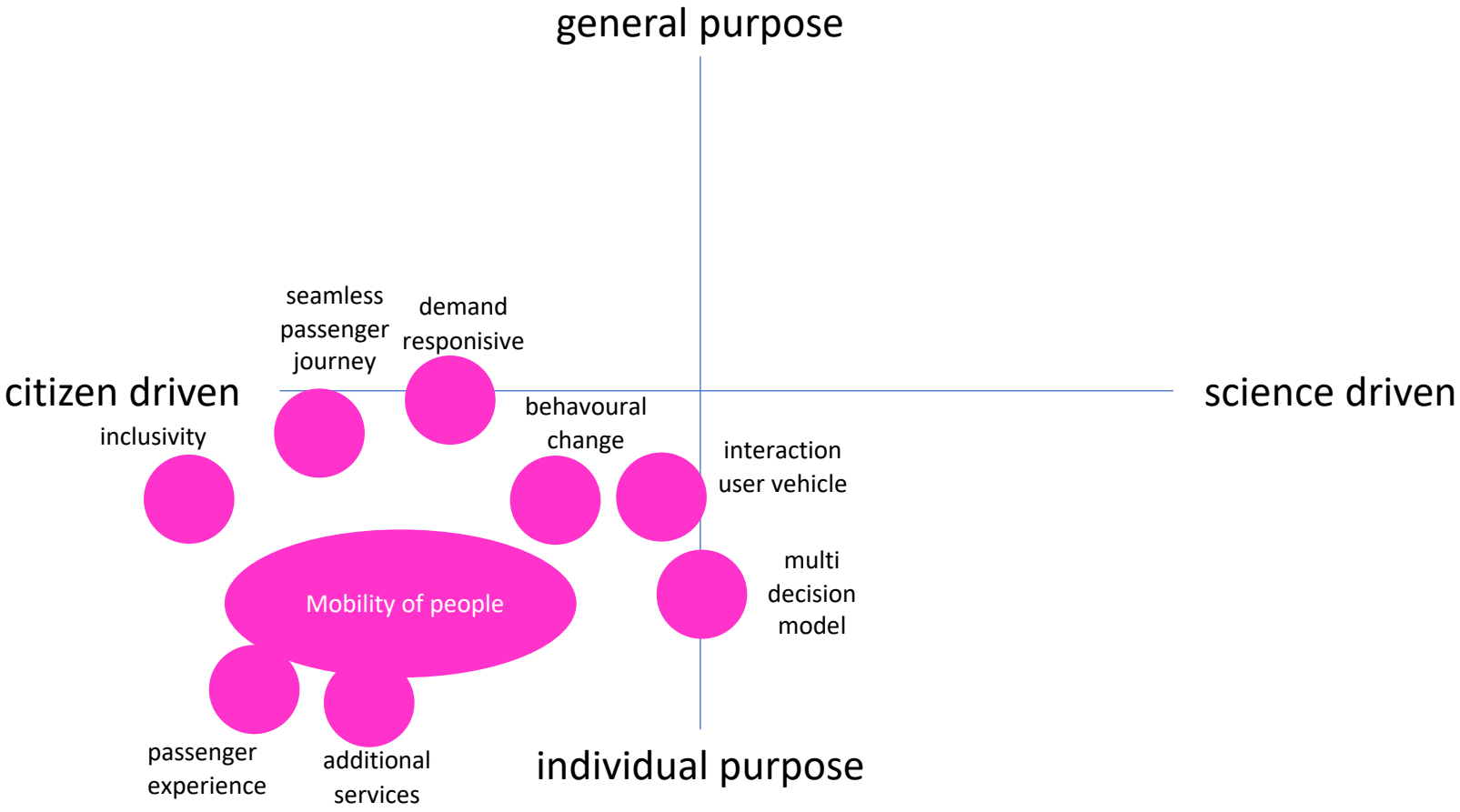
Mobility of people: Mapping of the different topics in pink



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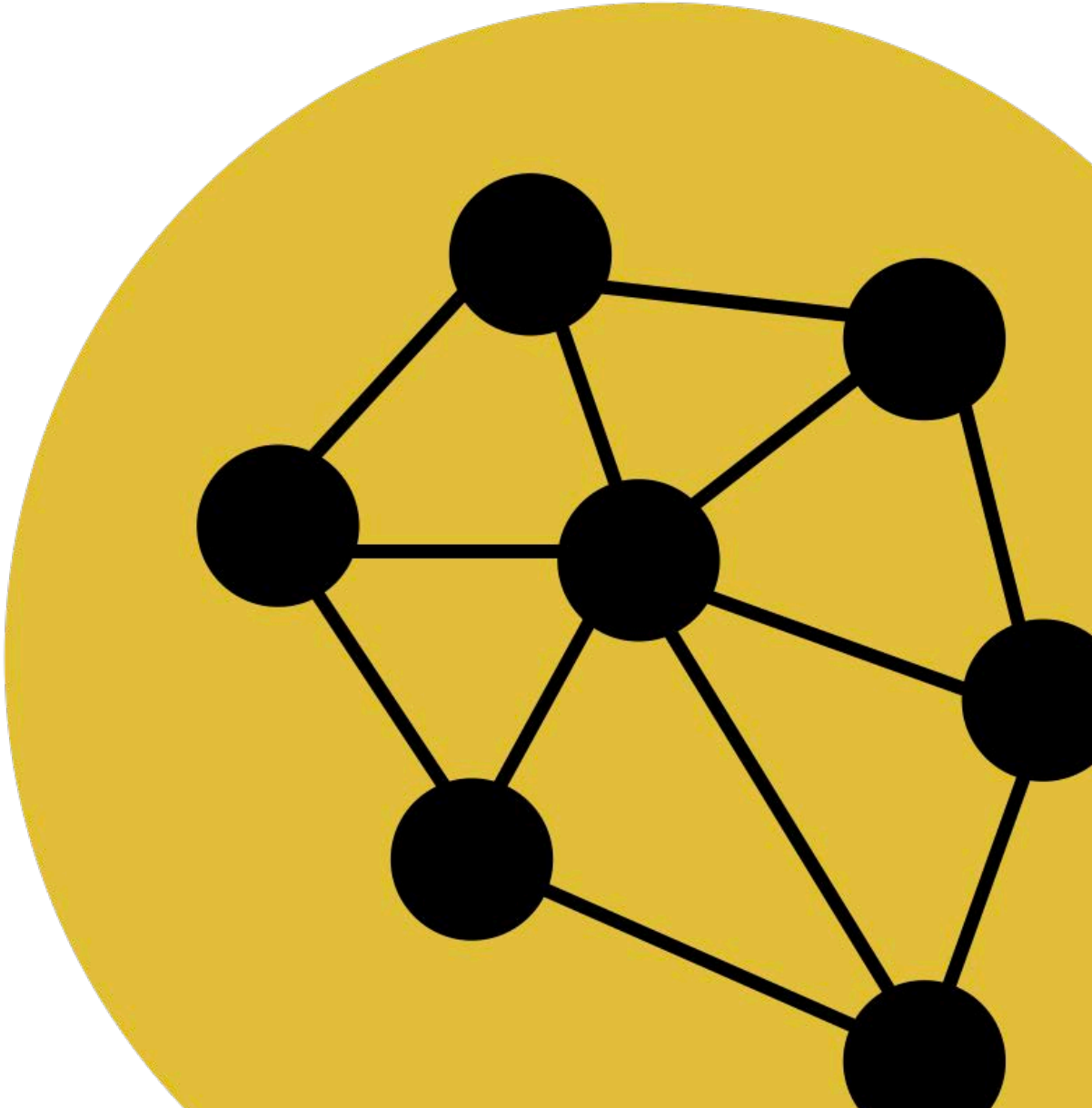
Mobility system



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The mobility system (1/5): Capacity

The current mobility system reaches their limits, the ring roads collapse during rush hour, and also train network is used at maximum capacity. At the same time public transport in the regions drives around empty. With public transport offered by the current parties it is assured that public transport remains an *affordable system* for the passenger, and services are also offered in the regions. This raises question about what would happen is private parties take over. They can offer services for lower prices to gain market share and stop offering services at locations that are not business viable.

- → How to keep grip and keep public transport affordable when private parties, such as google and uber take over?

Another way to deal with capacity are *shared vehicles*, this can be both for bikes and cars. This raised questions on how to design the infrastructure to have the right capacity at the right place at the right moment. Research is done into sensors to measure the capacity at certain points.

- → How to design system for shared vehicles that is sufficient and that we also want to use?

Eva Taylor Parkins met Suzanne Hiemstra, TU Delft, Benchmark analysis of different public transport tariff systems

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The mobility system (2/5): Electrification

Several researchers work on the *electrification of vehicles*. Not only on the design of the vehicles, but also on the charging infrastructure, the use the battery's for power at home and how to assure hybrid vehicles switch from diesel to electricity when entering zones where only electric vehicles are allowed. Not only the electrification, but also alternative fuels, such as hydrogen, are explored as possible alternative to our current fuels.

- → How the design the infrastructure for electric vehicles?
- → What are alternative fuels? (Maybe out of scope for the creative sector)

Electrification, but also other technologies for automation and connectivity raise questions on the *impact of technologies*. What do those technologies really mean when we use them in our daily life?

- → What's the impact of different technologies?

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The mobility system (3/5): City design

The future of mobility may impact our design of cities. Where we now more or less live where we work, this may change with autonomous vehicles when the travel time can be used more efficiently. There is also a development where all we need in our daily live is offered closely to where we live to reduce travel time, as for example with the superblocks in Barcelona or the 15 minute city in Paris. Another development is the role of cars and drivers in the cities. Whereas they had a central role in the past while designing cities, nowadays we see more and more car-free zones and more space for cyclers and pedestrians. At the same time we also see dedicated lanes for high end public transport and autonomous vehicles.
There also researchers focusing on the safety and the impact of *city design* on our safety. For example the use of 30km roads, the safety of a bus, car and bicycle, not only for the driver and passenger, but also for the ones being hit.

- → What's the impact of future mobility on city design?
- → How to design cities to implicitly realise safety?

Paris as 25 minute city, Embassy of Mobility. Foto: Eric Feferberg via Getty Images

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The mobility system (4/5): Multimodality

A system with many different modality requires insight in all *assets* (from vehicles, to parking spots and everything in between) and real-time information on all these assets and request and the same time.

- → How to assure all this data connects, provides the relevant information and is usable?

Autonomous *vehicles interact with their environment* and other traffic. At the same time it cannot decide what other vehicles, the environment or other road users do. This may also require vehicles to appear friendly or give feedback on what it's going to do.

- → How do we want vehicles to interact with its surrounding?
- → How do want vehicles to be perceived and what feedback should it provide to its surrounding?

All these new vehicles require new *regulations* on what's allowed and safe and what standards we need across counties. These more or less autonomous systems include more software that will be updated over time, which will affect our regulations and how we monitor how regulations are met. Also the insurances with autonomous vehicles require innovation when our current systems requires a person to be hold accountable.

- → What should the safety standards be for future vehicles?
- → How should future regulations for new vehicles look like?
- → How to monitor safety with constant software updates and keep grip on these developments?
- → How to deal with insurances with autonomous vehicles?

Planet Smart Mobility, Jos van Dam, InHolland, image: https://www.thuisduinen2050.nl

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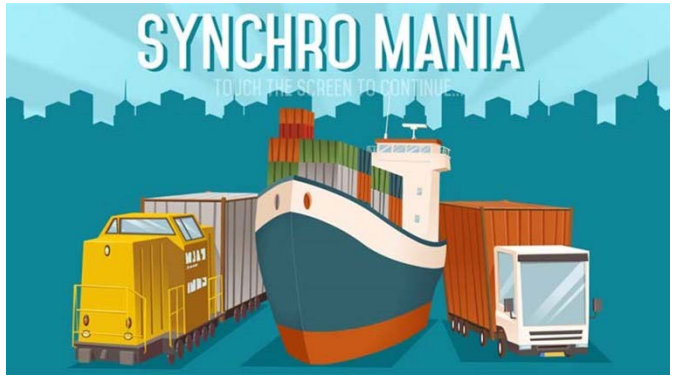
The mobility system (5/5): Hubs

There were different opinions on *mobility hubs*. Whereas some where focusing on the hubs and study how future hubs could and should look like others question whether we should want hubs. By giving the hub a central focus we place the mobility system at the centre instead of humans. Hubs should be a means and not a goal.
There are many types of hubs without a clear definition and with many different meanings. A few types mentioned: hubs in the suburbs, hubs at ring roads, hubs 10km from city centres, hubs in the periphery for alternative transport, but also location where at least two means of transport connect, or hubs for freight.

- → What are hubs and what role do we want them to have in our society?

Hubs are not only seen as connecting modalities, but also as places where other *functions of hubs* can be added to make hubs attractive, as for example, wifi, water tap points, workspaces, supermarkets, parcel pick-up points, central kitchen. More often hubs are not only seen as places where people can switch modalities, but also as places where freight is being processed. Parcel services drive around with half empty vehicles, while many delivery vehicles enter residential areas. This requires other solution where hubs are seen as a means to create solutions such as collective supply.

- → What other functions should be offered at hubs?
- → How to combine people and freight hubs?



TNO, Synchomodality, Efficiency, flexibility, sustainablr logistics sector, image: https://www.tno.nl/nl/aandachtsgebieden/mobiliteit-logistiek/roadmaps/smart-and-safe-traffic-and-transport/smart-mobility-and-logistics/data-driven-logistics/synchromodaliteit-efficiente-flexibele-en-duurzame-logistieke-sector/

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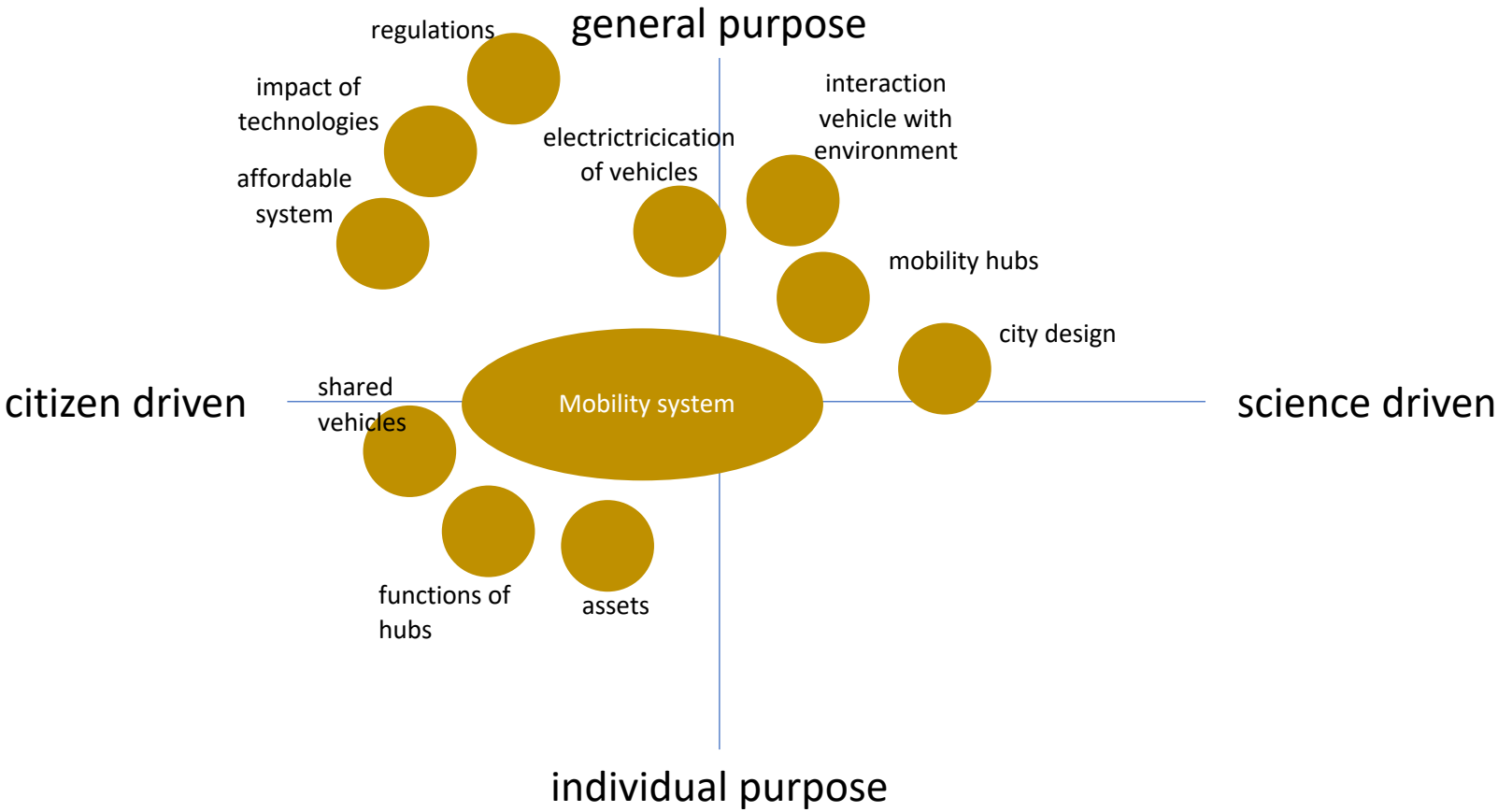
Mobility system: Mapping of the different topics in brown



Framework for mobility research topics.
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Context of mobility

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The context of mobility (1/2):

There are different developments that may effect our future mobility system. A clear example is current pandemic completely changing whether we travel and how we travel. Although we hopefully soon recover from this pandemic, it can be expected to have more shocks in the future. This requires a certain *resilience* in the system

→ How to design a resilient mobility system?

Another important development, also originated in the KIA, is *sustainability*. This does not only refer to zero emission and energy neutral systems, but also circularity, biodiversity, air quality, sound pollution, etc.

→ How to design a sustainable mobility system?

Another development mentioned was our *health* and requirement activity to stay healthy. This may also effect how we want our future mobility system to look like.

→ How to design a healthy mobility system?

Embassy of mobility, Arrivals coronaproof bussen, image: https://www.dezeen.com/2020/06/17/arrival-electric-bus-social-distancing-corinavirus/

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The context of mobility (2/2):

The researchers also mentioned *technological developments* and solution that were not directly part of a mobility system, but may effect the system, such as drones and digitization.

→ What are possible technologies effecting the mobility system and with their effect be?

A last topic mentioned was the balance between *human centred vs humanity centred*. This may lead to conflicting interests.

→ How to balance human centred vs humanity centred?

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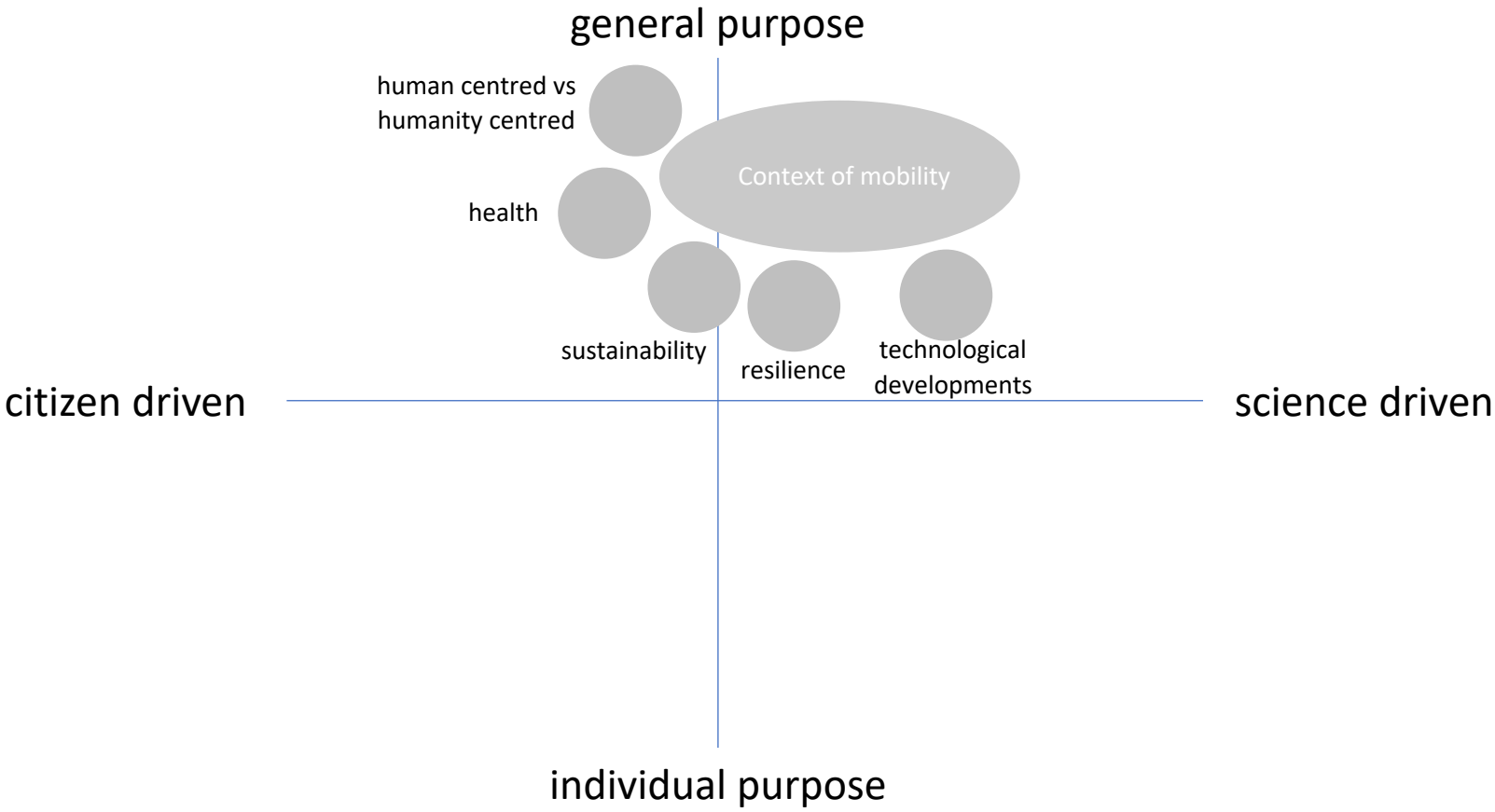
Context of mobility: Mapping of the different topics in grey



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The mobility designer

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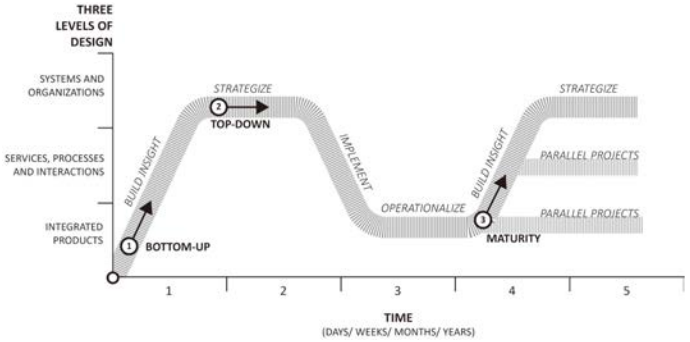
The mobility designer (1/2): Networked innovation

The design of the complex mobility systems with all its elements as described in the previous sheets requires *stakeholders to collaborate.* Such collaborations require different decision processes, different business models, different ways of procurement. It also requires organisational changes to be able to offer those future services.

- → How to collaborate in such networked innovation projects?
- → How to design in such networked innovation projects?
- → What are possible business models for future solutions?
- → How to tender the required solutions?
- → How to adjust the organisations to be able to offer the future services?

Designing for such complex systems requires the designers to be designing at *different hierarchies* at the same time. (e.g. user, organisation, system)

- → How to design at different levels at the same time?



Price, R. A., De Lille, C., & Bergema, K. (2019). Advancing Industry through Design: A Longitudinal Case Study of the Aviation Industry. She Ji: The Journal of Design, Economics, and Innovation, 5(4), 304-326.

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The mobility designer (2/2): A design approach

There is also an interest by the researchers on the value of a *design approach* in developing such complex mobility systems. Different methods and tools where mentioned to be relevant for this context.

- → What's the role & value of a design approach in developing such complex systems?
- → What's the role & value of specific (design) tools/approaches, such as living labs, citizen science, codesign, roadmaps, labs, experimentation, prototyping, in developing such complex systems?
- → What are valuable (design) methods for designers to be able to develop such complex systems?

For the future this requires different *skills* from designers, where they have to work even more multidisciplinary and transdisciplinary as nowadays.

- → What skills do we need to teach our future students?

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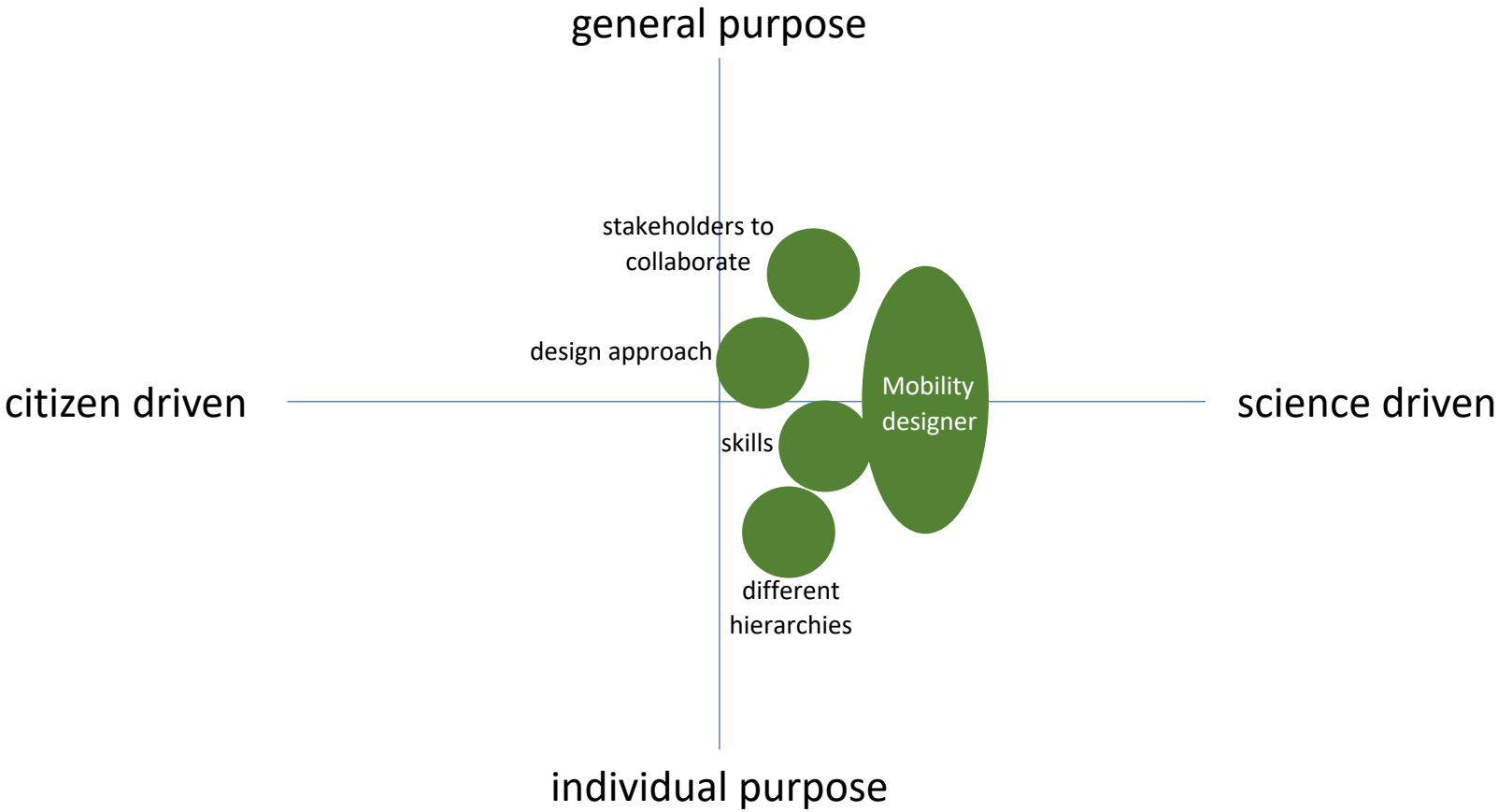
Mobility designer: Mapping of the different topics in green



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Researcher/teacher in mobility

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The researcher/teacher in mobility:

Research projects and subsidised project are seen as valuable means to build a *relationship* with industry partners.

→ How to build relationships through research?

It was experienced that more *data sharing* between researchers may be required to improve our quality, but at the same time researcher seem not always very willing to share data with colleagues.

→ How to improve data sharing between colleagues?

There is a risk of design *researchers* being put in the role of *designers* of the system. This task should be left to designers.

→ How to distinct design research from the actual design?

Involving students in research, and especially teaching *multidisciplinary* is difficult in the current education system where most of the teachers and well as the faculties are *monodisciplinary* and build on the specialities of the specific researchers and teachers.

→ How to involve students and teach multidisciplinary in a monodisciplinary system?

KLM & TU Delft, Design doing

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Sidenote: A broader view on mobility

Mobility is mostly seen as people moving from A to B in a physical system. As designers we could also look at mobility from a *broader context* and look at economic or financial mobility of a person. Or a persons social mobility. As design researchers we could or should focus on meaningful mobility in a broader context than just people moving from a to b in a physical context.

Another thing we noticed that in the mobility of people none of the researcher spoke about a focus on the employee in mobility.

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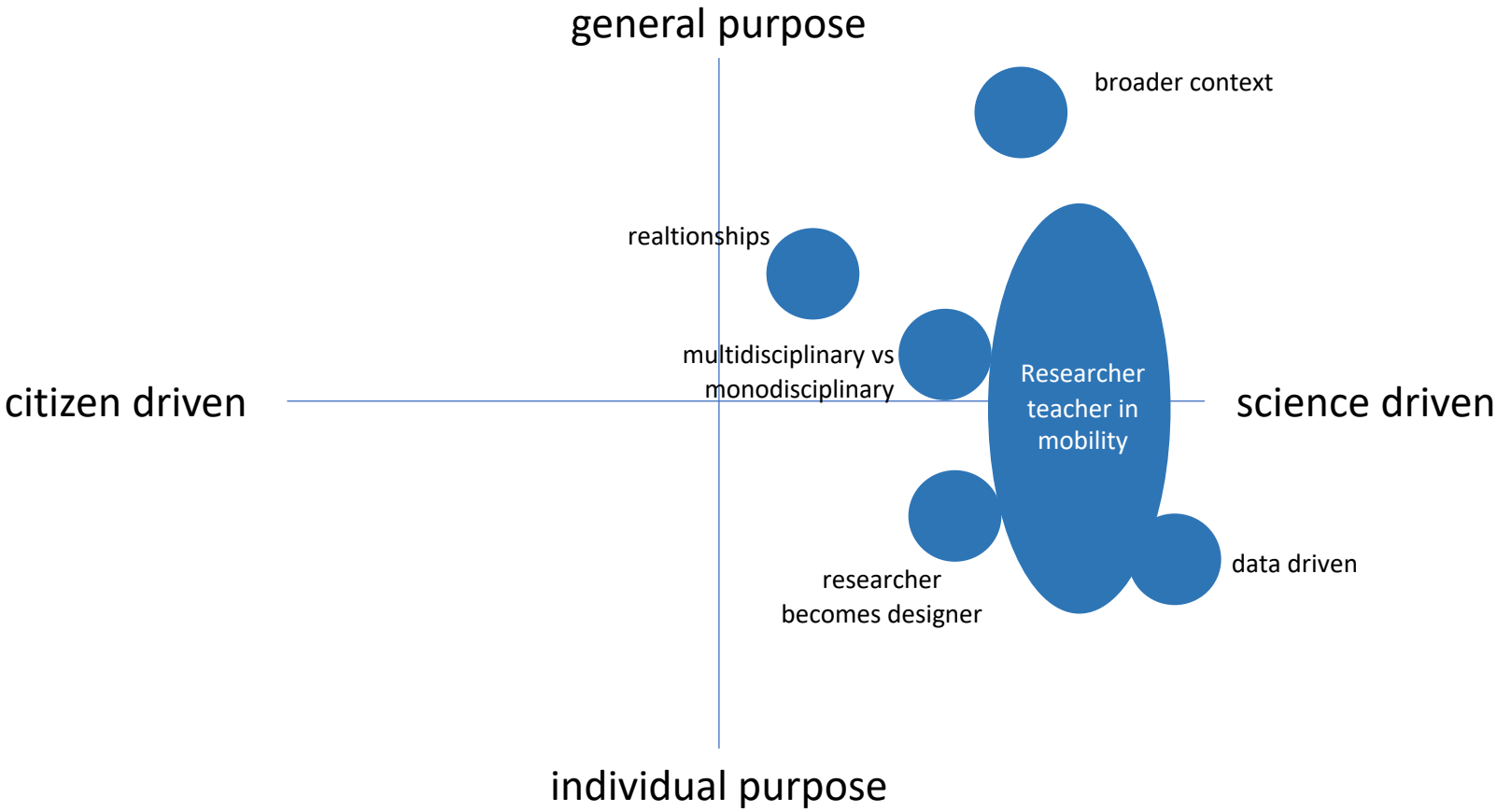
Researcher/teacher in mobility: Mapping of the different topics in blue



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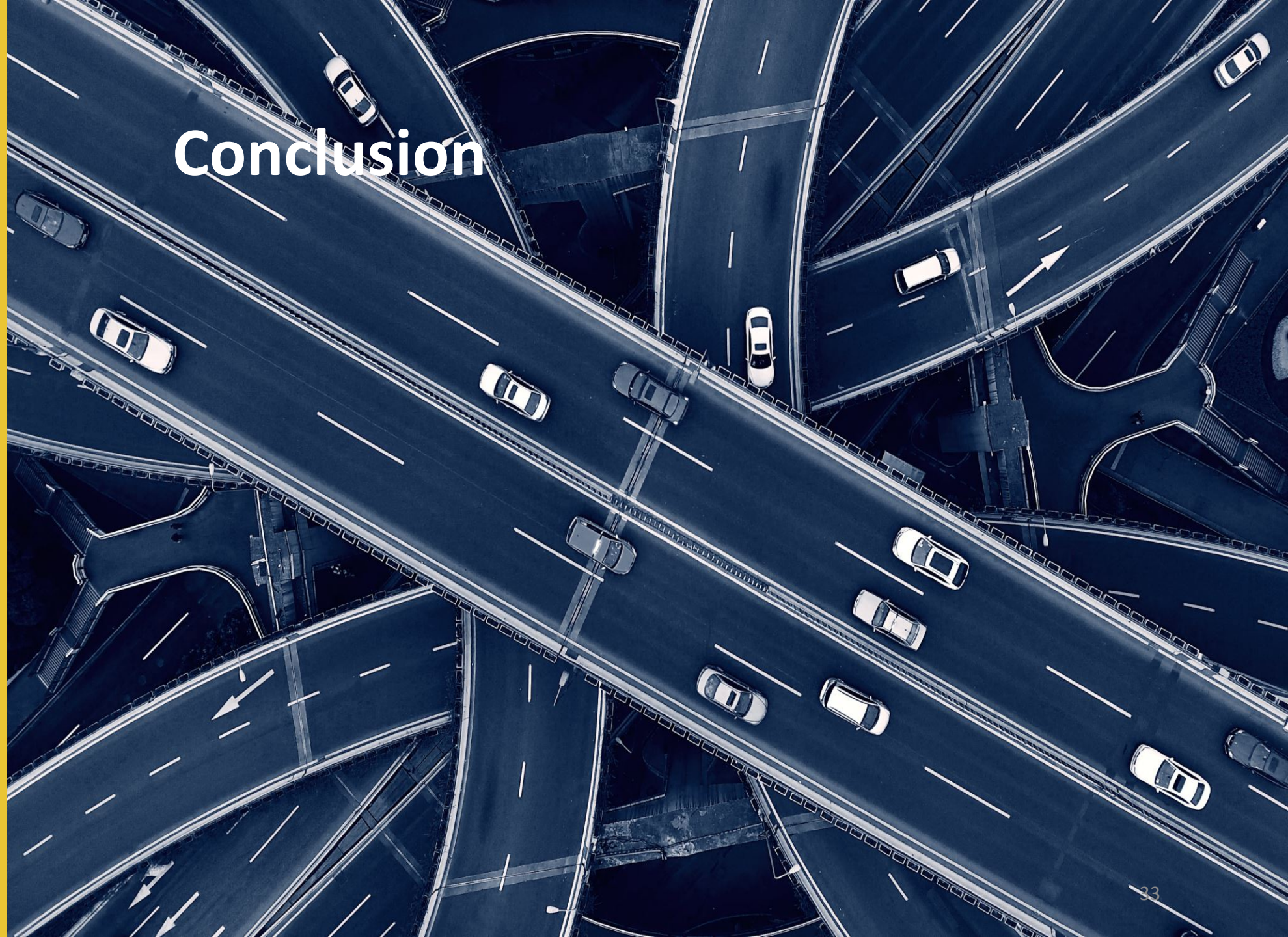
Conclusion



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Conclusions:

This report is based on an investigation into mobility research in The Netherlands, initiated by CLICKNL, Design United, the World Design Embassies, & the Dutch Design Foundation.

We learned that the projects and topics of researchers and practitioners are widely spread across modalities and across the themes used in this document. This leads to two main conclusions:

- The complexity of the transition to emission-free mobility for people & freight in 2050 is so large that researchers and practioners pick up parts. There appears not to be one solution. This calls for an overarching strategy.
- There is a need for focus.
  The themes in this report can serve as five focus points

The combination of a strategy and a focus also enables other researcher to enter the arena and contribute to the future of mobility in The Netherlands.

Next, we show the scatter diagram of all the themes together, then we give an overview of the research questions we have gathered and then we suggest a way forward.

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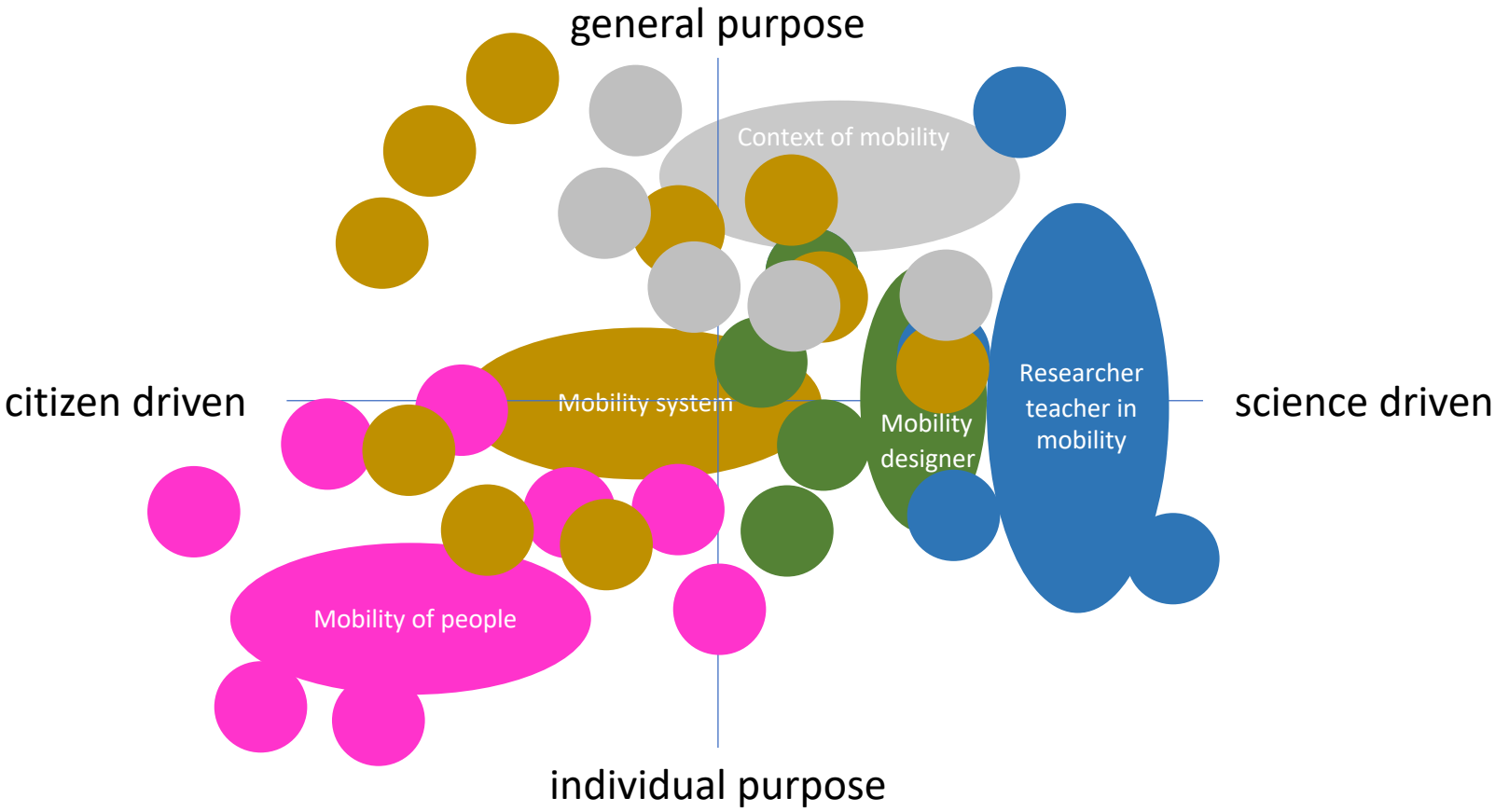
Conclusion on the themes: scatter diagram



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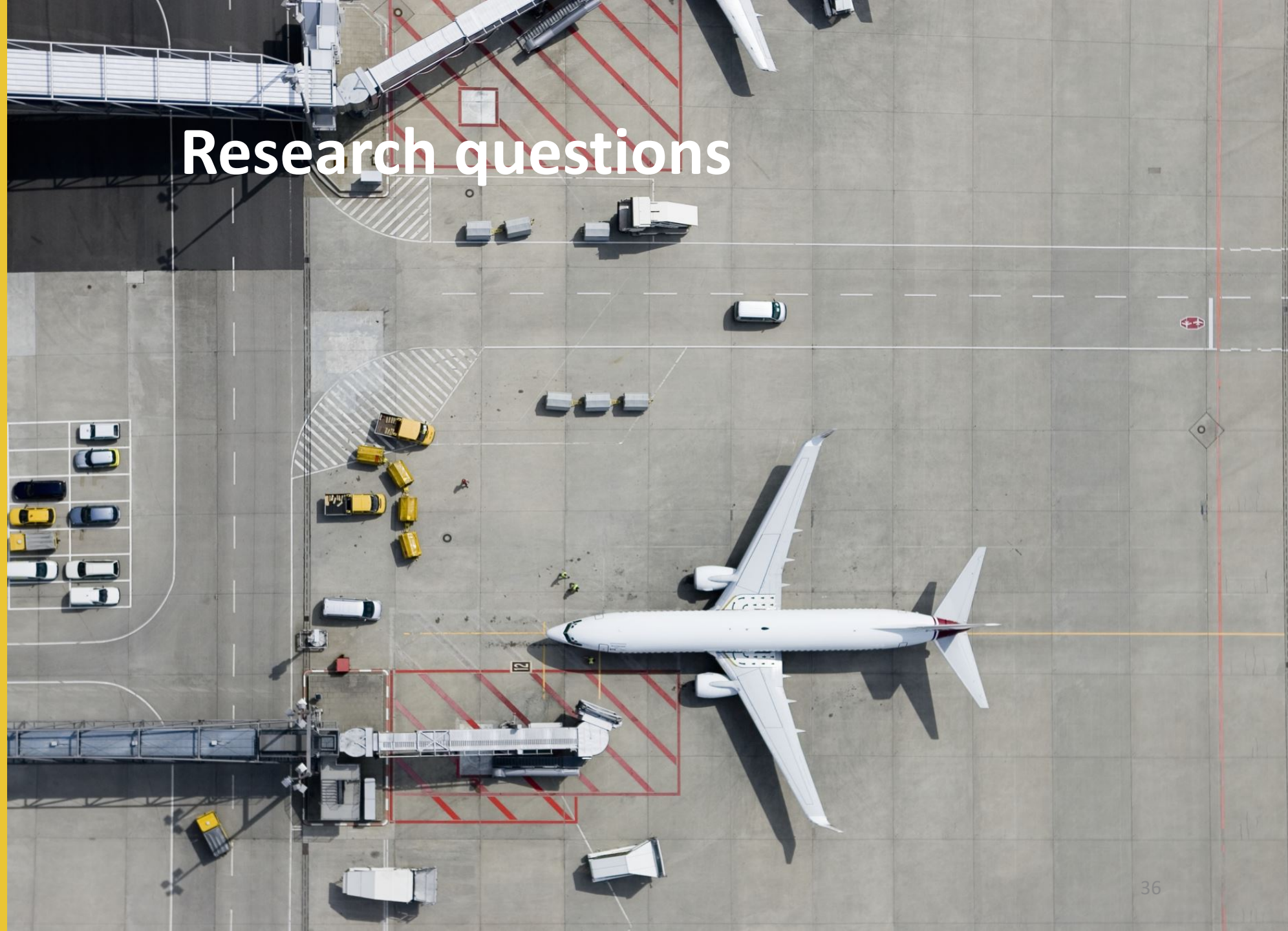
Research questions



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Research questions: Mobility of people
Possible future research questions when focusing on the mobility of people related to:

- User centricity
  - → How to design services/systems for all users?
  - → How to design services with high comfort, that unburdens users, and assure self control?
- Autonomous
  - → How to design the interaction between user and autonomous vehicle and what's a valuable role for the user?
  - → How to keep the drivers attention (autonomous vehicle)?
  - → How to create the trust matching the vehicle?
  - → What are additional services/activities in an autonomous vehicle?
  - → What is needed for the adoption of autonomous vehicles?
- Multi-modality
  - → How to design seamless personalised services including all modalities?
  - → How to design demand responsive services?
  - → How to include mood, experience, preferences in interactive multi-decision models?
  - → How to create behaviour change to sustainable modalities?
  - → What are additional services/activities at hubs?

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CHALLENGES IN MOBILITY RESEARCH

Research questions: Mobility system
Possible future research questions when focusing on the mobility system related to:

- Capacity
  - → How to keep grip and keep public transport affordable when private parties, such as google and uber take over?
  - → How to design system for shared vehicles that is sufficient and that we also want to use?
- Electrification
  - → How the design the infrastructure for electric vehicles?
  - → What are alternative fuels? (Maybe out of scope for the creative sector)
  - → What's the impact of different technologies?
- City design
  - → What's the impact of future mobility on city design?
  - → How to design cities to implicitly realise safety?

CHALLENGES IN MOBILITY RESEARCH

Research questions: Mobility system
Possible future research questions when focusing on the mobility system related to:

- Multimodality
  - → How to assure all this data connects, provides the relevant information and is usable?
  - → How do we want vehicles to interact with its surrounding?
  - → How do want vehicles to be perceived and what feedback should it provide to its surrounding?
  - → What should the safety standards be for future vehicles?
  - → How should future regulations for new vehicles look like?
  - → How to monitor safety with constant software updates and keep grip on these developments?
  - → How to deal with insurances with autonomous vehicles?
- Hubs
  - → What are hubs and what role do we want them to have in our society?
  - → What other functions should be offered at hubs?
  - → How to combine people and freight hubs?

CHALLENGES IN MOBILITY RESEARCH

Research questions: Context of mobility

Possible future research questions when focusing on the context of mobility:

- → How to design a resilient mobility system?
- → How to design a sustainable mobility system?
- → How to design a healthy mobility system?
- → What are possible technologies effecting the mobility system and with their effect be?
- → How to balance human centred vs humanity centred?

CHALLENGES IN MOBILITY RESEARCH

Research questions: Mobility designer
Possible future research questions when focusing on the mobility designer related to:

- Networked innovation
  - → How to collaborate in such networked innovation projects?
  - → How to design in such networked innovation projects?
  - → What are possible business models for future solutions?
  - → How to tender the required solutions?
  - → How to adjust the organisations to be able to offer the future services?
  - → How to design at different levels at the same time?
- A design approach
  - → What's the role & value of a design approach in developing such complex systems?
  - → What's the role & value of specific (design) tools/approaches, such as living labs, citizen science, codesign, roadmaps, labs, experimentation, prototyping, in developing such complex systems?
  - → What are valuable (design) methods for designers to be able to develop such complex systems?
  - → What skills do we need to teach our future students?

CHALLENGES IN MOBILITY RESEARCH

Research questions: Researcher/teacher in mobility

Possible future research questions when focusing on the researcher/teacher in mobility:

- → How to build relationships through research?
- → How to improve data sharing between colleagues?
- → How to distinct design research from the actual design?
- → How to involve students and teach multidisciplinary in a monodisciplinary system?

CHALLENGES IN MOBILITY RESEARCH

A possible way forward in Mobility Reasearch

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A possible way forward

We see three possible steps to create the future in Mobility Research:
(to arrive at emission-free mobility for people & freight in 2050)

A. Build an overarching strategy

Form a multidisciplinary taskforce, with representatives from CLICKNL, Design United, the World Design Embassies, the Dutch Design Foundation and the Universities.
Ask this group to write a strategy on emission-free mobility for people & freight.

B. Continue with the five focus themes

This makes mobility research more recognisable and illustrates added value to society.
Over time, continuously monitor the contribution from the themes and decide to stop one and add more themes if developments require that.

C. For ClickNl specifically:

Adapt the strategy in the business model and align subsidy to focus themes.

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References

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