FRIEDRICH-ALEXANDER
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# Disruptive Innovations for Sustainable Freight Transport

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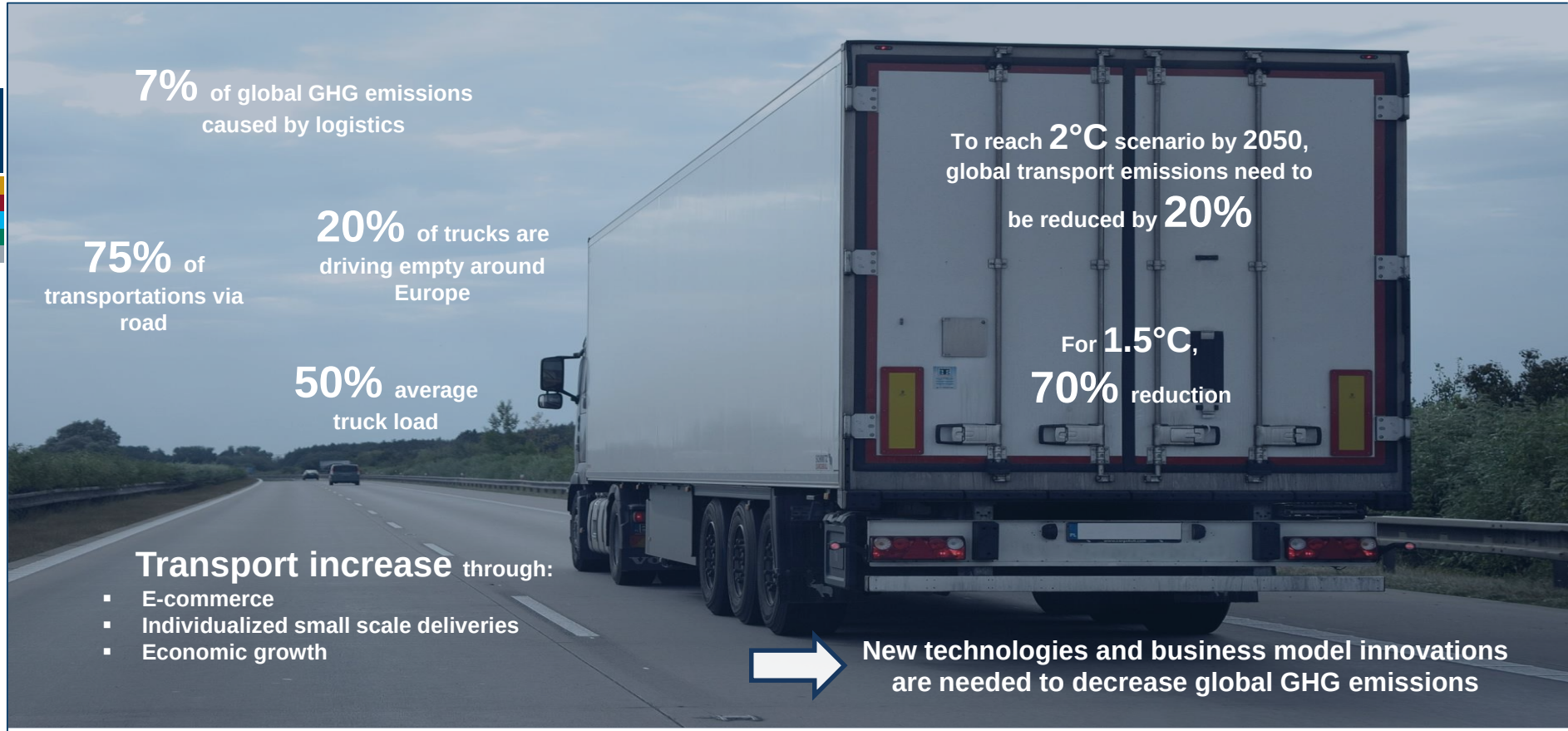
**Chair of Supply Chain Management**



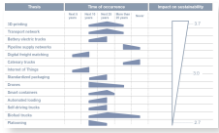

Stern (2008); European Environmental Agency (2001); Kersten et al. (2017); European Union (2017)

# Multi-rounded real-time Delphi method

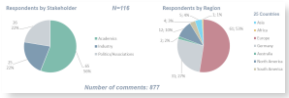
Innovation selection based on pre-survey and literature review

(1) Assessment
(2) Real-time feedback
(3) Possibility for re-assessment

Expert - Pool



Analysis of quantitative and qualitative results



Start

End

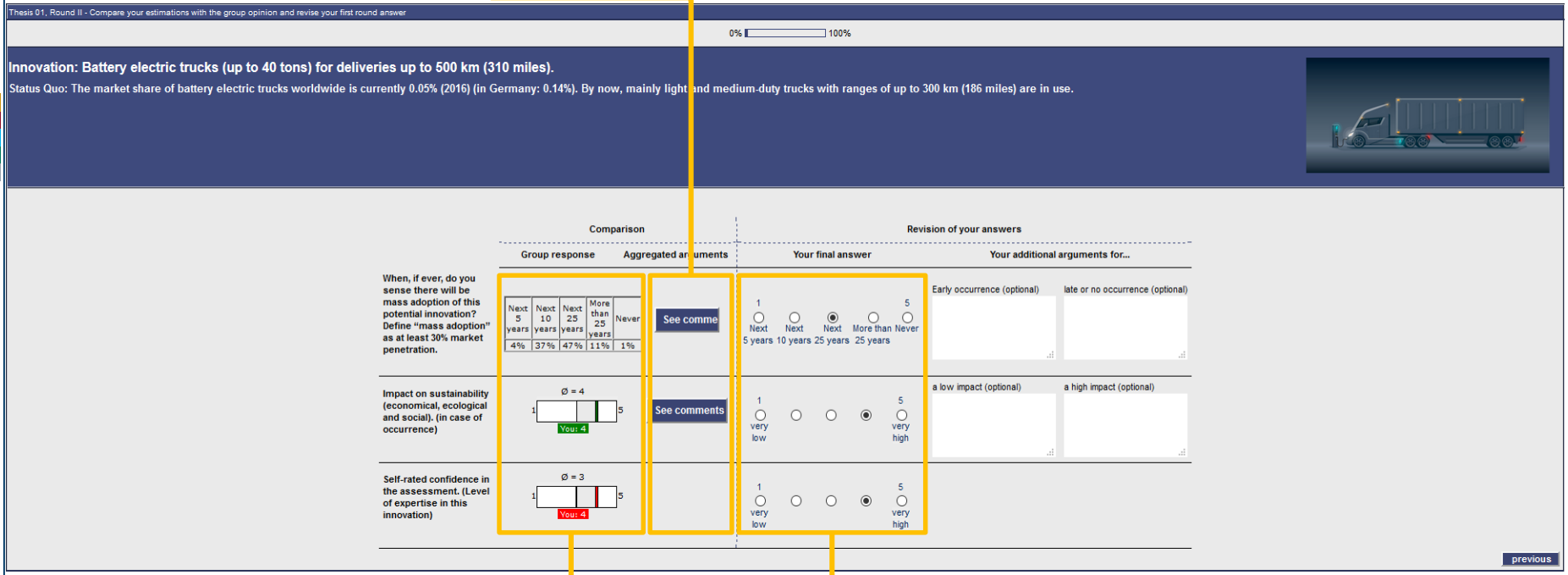
t = 6 weeks

# Surveyed innovations

1. **Battery electric trucks** (up to 40 tons) for deliveries up to 500 km (310 miles)
2. **Biofuel trucks** for long-haul deliveries (more than 500 km / 310 miles)
3. **Catenary technology** for heavy duty trucks (up to 40 tons) on highways
4. **Truck Platooning** on highways for long distances (more than 500 km / 310 miles)
5. **Self-driving trucks** for extra-urban traffic
6. **Pipeline supply networks** for long distance freight transport (more than 500 km / 310 miles)
7. **Drones** for last mile deliveries (up to 50 km / 32 miles) in urbanized areas
8. **Digital freight matching platforms** for last mile deliveries in urbanized areas
9. Freight is predominantly transported through a **shared open intermodal transport network** (Physical Internet)
10. **Internet of Things** to connect vehicle within a fleet and optimize freight transportation
11. Worldwide **modularized and standardized packaging** (from cargo container sizes to tiny sizes)
12. **Smart containers** elaborate the transportation route to their destination by themselves
13. Completely **automated loading and unloading** of transport vehicles through robotics or automated loading systems
14. Local **3D-printing** instead of transporting products

# Delphi study interface

**Option to see experts' comments**




**Own evaluation compared to group response**

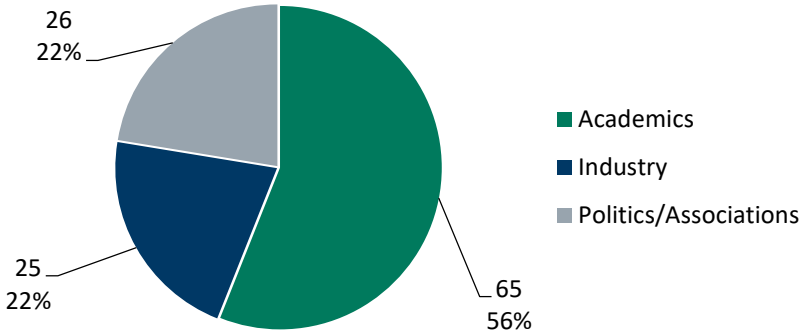
**Option to change own statements**

# Questionnaire and respondents

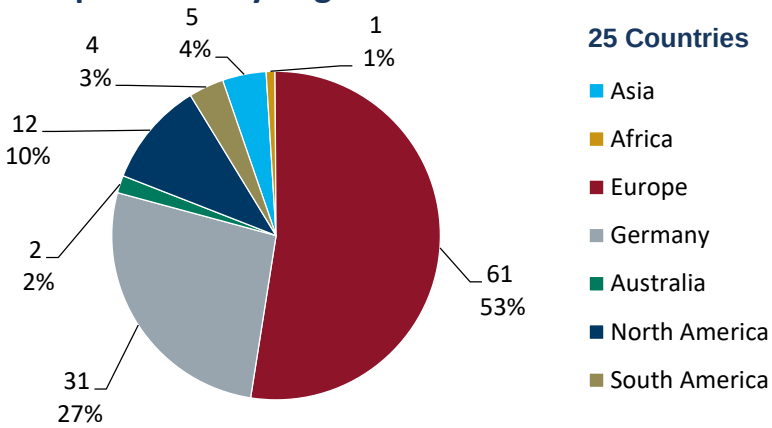
1. **When, if ever, do you sense there will be mass adoption of this potential innovation? Define “mass adoption” as at least 30% market penetration**
2. **Impact on sustainability (economical, environmental and social)**
   (in case of occurrence)
3. **Self-rated confidence in the assessment**
   (Level of expertise in this innovation)

## Respondents by Stakeholder

***N=116***

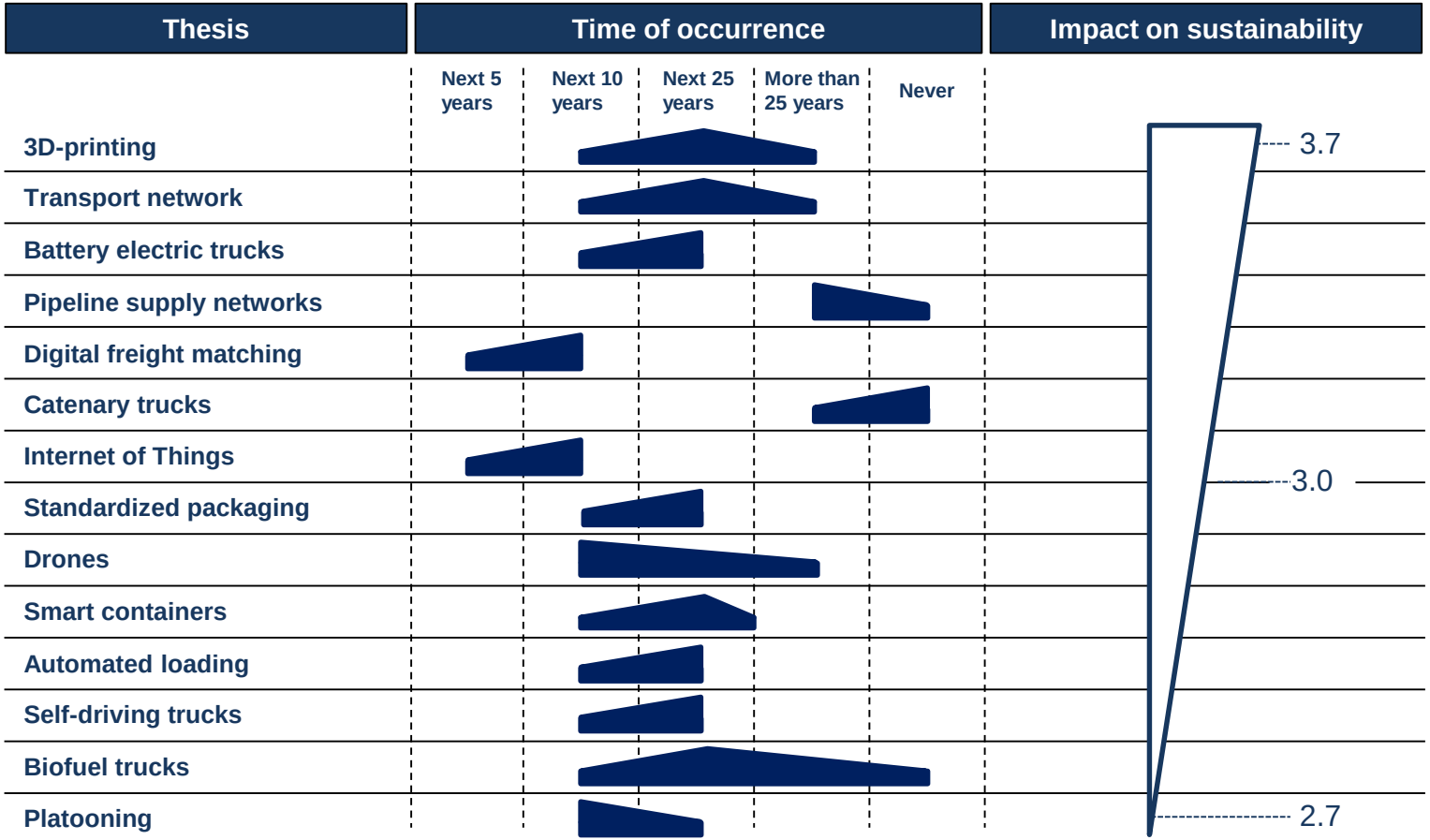



## Respondents by Region



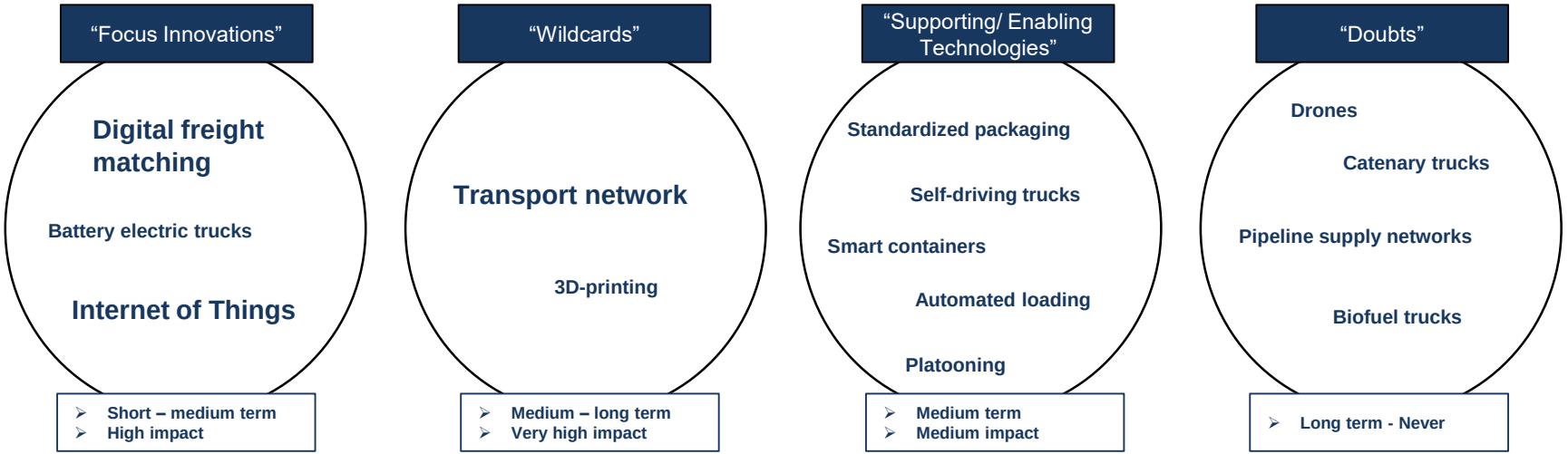

***Number of comments: 877***

# Results


Thesis
Time of occurrence
Impact on sustainability
Next 5 years
Next 10 years
Next 25 years
More than 25 years
Never
3D-printing
Transport network
Battery electric trucks
Pipeline supply networks
Digital freight matching
Catenary trucks
Internet of Things
Standardized packaging
Drones
Smart containers
Automated loading
Self-driving trucks
Biofuel trucks
Platooning
3.7
3.0
2.7

# Results

*Clustering of innovations depending on rated time of occurrence and Impact*




***"Truck utilization is key to sustainable transportation"***

# Results

*Qualitative expert comments on focus innovations*

***"Truck utilization is key to sustainable transportation"***

**FROM…**

**…TO**

## Digital freight matching

**(E)** *Governmental regulations can lead to an increase of adoption*

**(L)** *Integrated data sharing and collaboration, Priority and liability issues*


## Internet of Things

**(E)** *Technology already in place within some fleets*

**(L)** *High impact only across fleets and in combination with autonomous driving*

## Transport network

***(Physical Internet)***

**(E)** *Digital platforms pace the way, Governmental regulations and incentives can lead to faster adoption*

**(L)** *Horizontal collaboration and trust, Monopolistic*

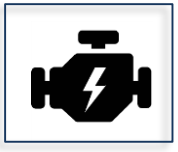
# Summary

*Key findings of the study*

**Implementation of innovations in transportation needs considerable time, due to long depreciation times of infrastructure and high costs.**

**Business Model innovations** (Transport Network, 3D-printing) **will have higher impact on sustainability than technological improvements of applied technologies** *(Self-driving trucks, Automated loading).*

**Governmental regulations and incentives play a significant role for innovations in logistics.**



**Propulsion technology of trucks will be diverse, depending on the application** (Battery electric mainly for short and medium haul).

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# Thank you for your attention!

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