E-Laas

Energy optimal urban Logistics As A Service

WUT contribution report

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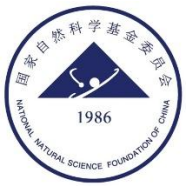

Project funding information

E-Laas project is carried out in an international consortium. Project coordinator in Europe: Chalmers University of Technology (Sweden), project coordinator in China: Shanghai University (China), consortium members: Tsinghua University (China), Warsaw University of Technology (Poland), cooperation partners: Stockholms stad, Trafikkontoret (Sweden), ParkUnload (Spain), Metropolis GZM (Poland), Shanghai Urban-Rural Construction and Transportation Department (China), Volvo Group Trucks Technology and Operations (Sweden).

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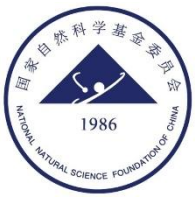

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1. Summary

This report presents the contribution of Warsaw University of Technology (WUT) to WP1, WP3, WP4, WP5 and WP6 of the E-Laas project. WUT's involvement in these work packages was primarily consultative and expert-based, with a focus on supporting the activities of the foreign consortium partners and ensuring consistency with the results developed in WP0 and WP2.

The contribution of WUT was based on knowledge and results related to urban logistics scenarios, delivery service types, transport relationships, survey outcomes, simulation assumptions, energy consumption, emissions and assessment indicators. These elements were used to support the interpretation of models, optimization approaches, stakeholder analyses and dissemination activities carried out within the project.

The report shows how WUT participated in the development and consultation of selected project tasks, including issues related to low-emission last-mile logistics, the use of public space, scalable urban logistics services, optimization under uncertainty, social acceptance and knowledge exchange. It also documents WUT's participation in project workshops, consortium meetings, scientific conferences and dissemination events.

2. Introduction

The E-Laas project addresses the development of energy-optimal urban logistics as a service, with particular attention to last-mile delivery systems in cities. Urban freight transport is increasingly shaped by the growing demand for fast and flexible deliveries, limited public space, congestion, environmental constraints and the need to reduce energy consumption and emissions. These challenges require approaches that combine transport modelling, logistics optimization, stakeholder analysis and urban policy considerations.

WUT participated in the project as one of the consortium partners. Its main research activities were carried out in WP0 and WP2, where WUT developed the basis for scenario building, the analysis of the Górnośląsko-Zagłębiowska Metropolis case, the classification of urban delivery services, survey-based assessment of stakeholder behaviours, and modelling and simulation of delivery processes.

The results developed by WUT provided a reference point for selected activities in WP1, WP3, WP4, WP5 and WP6. They made it possible to relate models, algorithms, stakeholder-oriented analyses and dissemination activities to practical urban logistics conditions, operational constraints and the needs of different participants in last-mile delivery systems.

3. Purpose and scope of the report

The purpose of this report is to document the role of WUT in WP1, WP3, WP4, WP5 and WP6 of the E-Laas project. The report describes the scope of WUT involvement in each of these work packages and explains how WUT supported the project partners through consultations, expert input, scenario interpretation, data background and dissemination activities.

The report covers five areas of contribution: dynamic use of public urban space to foster low-emission modes for the last mile in WP1, efficient and scalable models for energy-minimal

urban logistics services in WP3, optimization algorithms and optimization under uncertainty in WP4, societal awareness, stakeholders and urban policy in WP5, and dissemination of results and knowledge exchange in WP6. For each area, the report identifies the type of WUT support, its connection with WP0 and WP2, and the relevance of the respective work package for WUT analyses.

The scope of the report is limited to the internal contribution of WUT to the above-mentioned work packages. It does not replace the deliverables prepared by the leaders of WP1, WP3, WP4, WP5 and WP6. Instead, it complements them by providing a structured overview of WUT's participation in the joint research, consultation, modelling and dissemination process within the E-Laas project.

4. WP1 - dynamic use of public urban space to foster low-emission modes for the last mile

Within WP1, WUT participated in consulting scenarios for the use of loading and unloading zones, parking places, microhubs and charging infrastructure in urban delivery processes. WUT contributed a systemic perspective to the partners' work, treating public space as an element of the functioning of the urban logistics system.

The work carried out by WUT primarily included an analysis of the relationships between the organization of last-mile deliveries and elements such as: the type of logistics service, the sender-recipient relationship, means of transport, delivery time, spatial constraints, availability of charging infrastructure, and the impact of delivery organization on energy consumption, emissions and the quality of service for recipients. WUT also participated in the analysis of problems related to the availability of stopping places, the time spent searching for an unloading place and vehicles stopping in prohibited locations.

An important element of the work was the use of results previously developed in WP0 and WP2. In particular, urban delivery logistics scenarios, the classification of types of transport services, the characteristics of transport relationships, the structure of parcel dispatch and collection points, and the results of surveys concerning the behaviours of participants in the delivery system were used. This made it possible to analyse loading zones, microhubs and charging infrastructure in relation to real urban logistics processes.

The subject matter of the work carried out in WP1 was also discussed during project workshops and consortium meetings with the CUT partner. This concerned in particular issues related to practical variants of routing problems, electric vehicles, dynamic and stochastic problems, and constraints occurring in real last-mile delivery systems. These issues were subsequently developed in publications prepared by the project partners.

5. WP3 — efficient and scalable models for energy-minimal urban logistics services

Within WP3, WUT supported the project partners by providing and consulting the scenario background, data context and simulation assumptions developed in WP0 and WP2, which were used to interpret and validate models of urban logistics services. The results developed by WUT in WP0 and WP2 were of particular importance here, including reference scenarios for the Górnośląsko-Zagłębiowska Metropolis, the classification of delivery types, the structure of

transport relationships and an approach integrating macrosimulation and microsimulation modelling.

WUT consulted how different segments of urban logistics were represented in the models, including ready-made food delivery, boxed-meal delivery, parcel delivery with home and parcel locker channels, and B2B urban freight as a supplementary or future research context. An important element of the work was also the definition of model assessment indicators covering service completion time, operating costs, energy consumption, emissions and the quality of service for recipients.

An important element of cooperation consisted of consultations conducted with Shanghai University during project workshops, working seminars and consortium meetings. They concerned primarily models of routing, scheduling and organization of urban logistics services carried out using various means of transport, including truck-and-drone systems and new models of last-mile deliveries. These consultations were consistent with research directions developed by the project partners, especially in relation to truck-and-drone systems, routing and scheduling models, instant delivery services and scalable last-mile logistics service models.

The scope of consultations conducted by WUT was consistent with the issues developed in these works, especially with regard to types of urban transport services, the organization of service points, variants of the use of means of transport, and the assessment of the effects of delivery organization in terms of service completion time, energy consumption, emissions and service quality.

6. WP4 — optimization algorithms and optimization under uncertainty

Within WP4, WUT supported the project partners in the interpretation and assessment of optimization algorithms developed for urban delivery logistics. WUT's participation concerned primarily consulting how algorithmic solutions could be related to practical problems of organizing last-mile deliveries, vehicle routing, the use of electric vehicles, infrastructure constraints and the functioning of delivery systems under conditions of variable data and uncertainty.

This support was also related to the interpretation of dynamic and online decision-making logic, including the updating of routes and operational decisions when new information becomes available about orders, vehicles, infrastructure constraints or traffic conditions.

The results developed by WUT in WP0 and WP2 were used in this work. Urban delivery logistics scenarios, the characteristics of transport relationships, the structure of dispatch and collection points, and assumptions concerning different means of transport made it possible to embed optimization problems in the realities of urban delivery processes. In turn, the results of WP2, in particular simulation assumptions and assessment indicators, made it possible to analyse the effects of optimization decisions in terms of delivery time, route length, energy consumption, emissions, vehicle utilization and service quality.

An important element of cooperation consisted of consultations conducted with the TU partner during project workshops and consortium meetings. They concerned issues related to routing, coordination of different means of transport, deliveries carried out using trucks and drones, and optimization of routing and charging of electric vehicles. The consultations were consistent

with the WP4 research direction concerning coordinated truck-and-drone deliveries, routing under operational constraints and charging-related optimization problems.

7. WP5 — societal awareness, stakeholders and urban policy

Within WP5, WUT participated in analyses concerning social awareness, stakeholder behaviours and urban policies related to last-mile logistics. The scope of WUT's participation was linked to the task concerning the translation of social awareness, preferences and constraints of system participants into costs, constraints or parameters that could be used in decision-making, simulation and optimization models.

The basis for these analyses was the results of surveys developed and conducted by WUT within WP2. The surveys covered users of transport services, logistics operators, delivery providers and representatives of municipalities and districts. A total of 2,427 questionnaires were obtained. The scope of the research included, among others, preferences concerning parcel collection, barriers to the implementation of low-emission solutions, the functioning of urban infrastructure, actions of local administration and the social perception of urban transport services. This made it possible to relate stakeholder preferences and constraints to the three levels of responsibility considered in the project: recipients or customers, logistics service providers, and local authorities.

These results were used in WP5 as a basis for assessing the impact of user behaviours, the expectations of logistics operators and the decisions of local authorities on the organization of urban delivery processes. WUT also participated in consulting the way in which these elements should be taken into account in the models and analyses developed by the project partners.

8. WP6 — dissemination of results and knowledge exchange

Within WP6, WUT disseminated the project results through scientific publications, conference presentations, project workshops, expert panels and consortium meetings. These activities concerned primarily the results of WUT's work in the field of urban logistics scenarios, surveys, macro- and microsimulation modelling, energy consumption, emissions, scaling of results and assessment of last-mile delivery systems.

The E-Laas workshops in Warsaw, Hangzhou and Gothenburg were of particular importance, during which the results were presented, consulted and confronted with approaches developed by foreign partners. Conferences and scientific and industry events were also an important element of dissemination activities; during these events, project results concerning urban logistics, transport modelling, microsimulation, energy intensity of deliveries, emissions and behaviours of users of logistics services were presented.

Year	Event	Scope of WUT participation / presented content
2023	Logistic Systems – Theory and Practice / LSTP 2023	Panel "Energy-efficient City Logistics"; presentation of the E-Laas project and discussion on urban logistics.

2023	ENUAC Sino-European Kick-off Joint Meeting	Presentation of the E-Laas project by European partners, including WUT.
2024	8th National Scientific and Technical Conference "Modelling 2024 – Travel Modelling and Traffic Forecasting"	Presentation on methods of urban logistics modelling.
2024	E-Laas Workshop, Warsaw	Project workshops on macrosimulation modelling, microsimulation and energy management in urban logistics.
2024	Logistic Systems – Theory and Practice / LSTP 2024	Presentations on energy management, model regions, EVRP and urban logistics microsimulation.
2025	Winter School of Reliability / ZSN 2025	Poster on the efficiency of using truck convoys in last-kilometre deliveries.
2025	Future of the TSL Sector – Synergy of Science, Technology and Business / MT TSL 2025	Presentation "Energy-optimal logistics as a service".
2025	Sustainable Mobility in Urban Space / SMUS 2025	Presentation on trips related to collecting parcels from parcel lockers.
2025	Asia-Pacific Conference on Transportation and the Environment / APTE 2025	Presentations on microsimulation scaling, energy consumption and last-mile deliveries.
2025	E-Laas Workshop, Hangzhou	Project workshops on emissions modelling and microsimulation of delivery processes.
2025	International Scientific Conference "Transport of the 21st Century"	Presentations on transport policies, emissions modelling and the energy intensity of deliveries.
2025	Cargo Bike Festival	Participation in an event concerning low-emission forms of urban deliveries.
2025	Transport Systems Theory & Practice Conference / TSTP 2025	Presentation on the preferences of courier service customers.
2025	MT-ITS 2025	Presentation on clustering of transport zones.
2025	European Transport Conference 2025	Presentation on the implementation of sustainable urban logistics solutions.
2025	ENUAC Sino-European Winter Academy	Participation in the PhD & Postdoc Presentations session within the E-Laas project.
2025	Logistics conference "Modern Logistics – Directions of Development and Future Challenges", Sectoral Skills Centre in Logistics	Presentation on drones in logistics and their future role in last-mile delivery.
2025	2nd Conference "Autonomous Transport 2025"	Presentation on the use of UAVs in last-mile logistics - opportunities, constraints and potential benefits

2026	Winter School of Reliability / ZSN 2026	Poster on a multi-criteria model for the location of warehouse facilities.
2026	Conference "Innovations in Logistics and Production"	Presentations on micro-fulfilment centers and UAV applications in last-mile logistics.
2026	PTV Group Polska Users' Meeting 2026	Presentation on modelling pollutant emissions in PTV Visum and COPERT.
2026	E-Laas Workshop, Gothenburg	Project workshops on micro-fulfilment centers, microsimulation of deliveries using drones and clustering of transport zones.

The above events constituted the basic channel for disseminating and consulting WUT results within the project. During them, both the results of scenario and survey work were presented, as well as the results of macro- and microsimulation modelling, analyses of energy intensity, emissions and scaling of urban logistics models. The E-Laas project workshops in Warsaw, Hangzhou and Gothenburg additionally served as working consortium meetings, during which progress of the work was discussed, directions for further analyses were consulted and WUT results were confronted with approaches developed by foreign partners.

9. Matrix of WUT participation in WP 1, WP3, WP4, WP5, WP6

WP	Work carried out by WUT	Connection with WP0 and WP2 and elements used	Use of the results of a given WP in WUT work in WP0 and WP2
WP1	• WUT consulted scenarios for the use of loading and unloading zones, parking places, microhubs and charging infrastructure in delivery processes. • WUT consultations covered the relationships between delivery organization and the type of service, the sender-recipient relationship, means of transport, delivery time, spatial constraints and the availability of charging. • WUT consulted practical delivery service problems, such as the time spent searching for an unloading place, limited availability of	• WP1 used WP0 as a context for urban logistics scenarios, types of services, transport relationships and the structure of dispatch and collection points. This made it possible to relate loading zones, microhubs and charging infrastructure to real delivery processes. • WP1 also used WP2 as a source of survey data and assumptions concerning parking places, service time, routes, energy and emissions.	• The results and consultations from WP1 were used in WP2 in interpreting parking, loading and unloading problems. • They influenced the way the availability of stopping places, charging infrastructure and spatial constraints were included in

	stopping places and parking in prohibited locations.		delivery modelling.
WP3	• WUT consulted the validation of models developed in WP3, relating their results to the simulation developed in WP2 and to the scenario assumptions, input data and assessment indicators used in the project. • WUT consulted the practical validity of the model results, in particular their consistency with the realities of urban delivery logistics, types of services, transport relationships, service time, energy consumption, emissions and quality of service for recipients. • WUT consulted possibilities for improving models when their results were not consistent with the WP2 simulation or practical observations.	• WP3 used WP0 as a description of the GZM case, types of deliveries, system participants, transport relationships and ways of assessing results. • Thanks to WP0, partner models could be related to real situations in urban logistics. • WP3 used WP2 in the scope of survey results, delivery parameters, service times, simulation assumptions and indicators concerning urban logistics, energy consumption and pollutant emissions.	• The results and consultations from WP3 were used in WP2 to interpret the scalability of simulation models, to compare partner modelling approaches with WUT microsimulation and macrosimulation results, and to support the validation of assumptions concerning urban logistics service models.
WP4	• WUT consulted how solutions developed in WP4 could operate under conditions of variable data, e.g. when new information appears about orders, vehicles, routes or urban constraints. • WUT consulted whether the ongoing updating of routes and logistics decisions could support the practical organization of last-mile deliveries, in particular in terms of delivery time, vehicle utilization, energy consumption and emissions.	• WP4 used WP0 as a description of delivery scenarios, transport relationships, dispatch and collection points and variants of the use of different means of transport. • Thanks to WP0, algorithms and optimization solutions could be related to real conditions of urban delivery logistics, and not only to theoretical examples.	• The results and assumptions from WP4 were used in WP2 in interpreting algorithms in the simulation environment, implementing routing logic, assessing delivery variants and analysing results using indicators of time, distance, energy consumption,

	• WUT consulted the interpretation of algorithm results in relation to urban logistics scenarios and assessment indicators used in WP0 and WP2.	• WP4 used WP2 in the scope of simulation assumptions and assessment indicators, such as delivery time, route length, energy consumption, emissions, vehicle utilization and service quality. • The WUT approach combining city-scale traffic analysis with the analysis of individual transport operations helped interpret the effects of applying optimization for decision-making.	emissions and vehicle utilization.
WP5	• WUT consulted how social awareness, preferences and behaviours of users, delivery providers, operators and local administration could be taken into account in urban logistics models. • WUT consulted how social factors could be transformed into parameters, costs, constraints or boundary conditions used in modelling and optimization. • WUT consulted the interpretation of WP2 survey results in the context of the needs of models and optimization solutions developed in the project.	• WP5 was particularly connected with WP2 because it used the results of WUT surveys concerning users, operators, delivery providers and local administration. • Data from WP2 made it possible to analyse user preferences, barriers to the implementation of low-emission solutions, infrastructure needs and possible actions of public administration. • WP5 used WP0 as a description of urban logistics scenarios, types of transport services and variants of transport organization. • Thanks to WP0, stakeholder behaviours could be related to	• The results of WP5 were used in WP2 in the analysis of survey data and the interpretation of user behaviours, operator barriers, recipient preferences, actions of local authorities and acceptance of low-emission solutions.

		specific last-mile delivery processes.	
WP6	• WUT consulted the definition of target groups for dissemination activities, in particular stakeholders of urban delivery logistics, the public sector, the private sector, logistics operators and the scientific community. • WUT consulted the selection of channels and frequency of disseminating project results, such as workshops, consortium meetings, conferences, industry events, expert panels and publications. • WUT co-organized project workshops, including a partner meeting in the first year of the project, and participated in events serving knowledge exchange between partners and stakeholders. • WUT participated in discussions with representatives of the public and private sectors concerning urban freight transport, urban policies and possible interventions supporting last-mile logistics.	• WP6 used WP0 as a basis for presenting urban logistics scenarios, the GZM case, types of services and the organization of delivery processes. • WP6 used WP2 in disseminating survey results, simulation models, energy and emissions analyses, and conclusions concerning the behaviours of participants in the delivery system. • The results of WP0 and WP2 were presented and consulted during workshops, conferences, consortium meetings and expert events. • WP6 served the exchange of knowledge and dissemination of WP0 and WP2 results among project partners and external stakeholders.	• The dissemination activities in WP6 supported the presentation and external consultation of WP0 and WP2 results, including scenarios, survey findings, simulation models, datasets, energy and emission analyses, and policy-oriented conclusions.

A schematic presentation of WUT's contribution to the implementation of the individual tasks of the project's foreign partners is shown below.

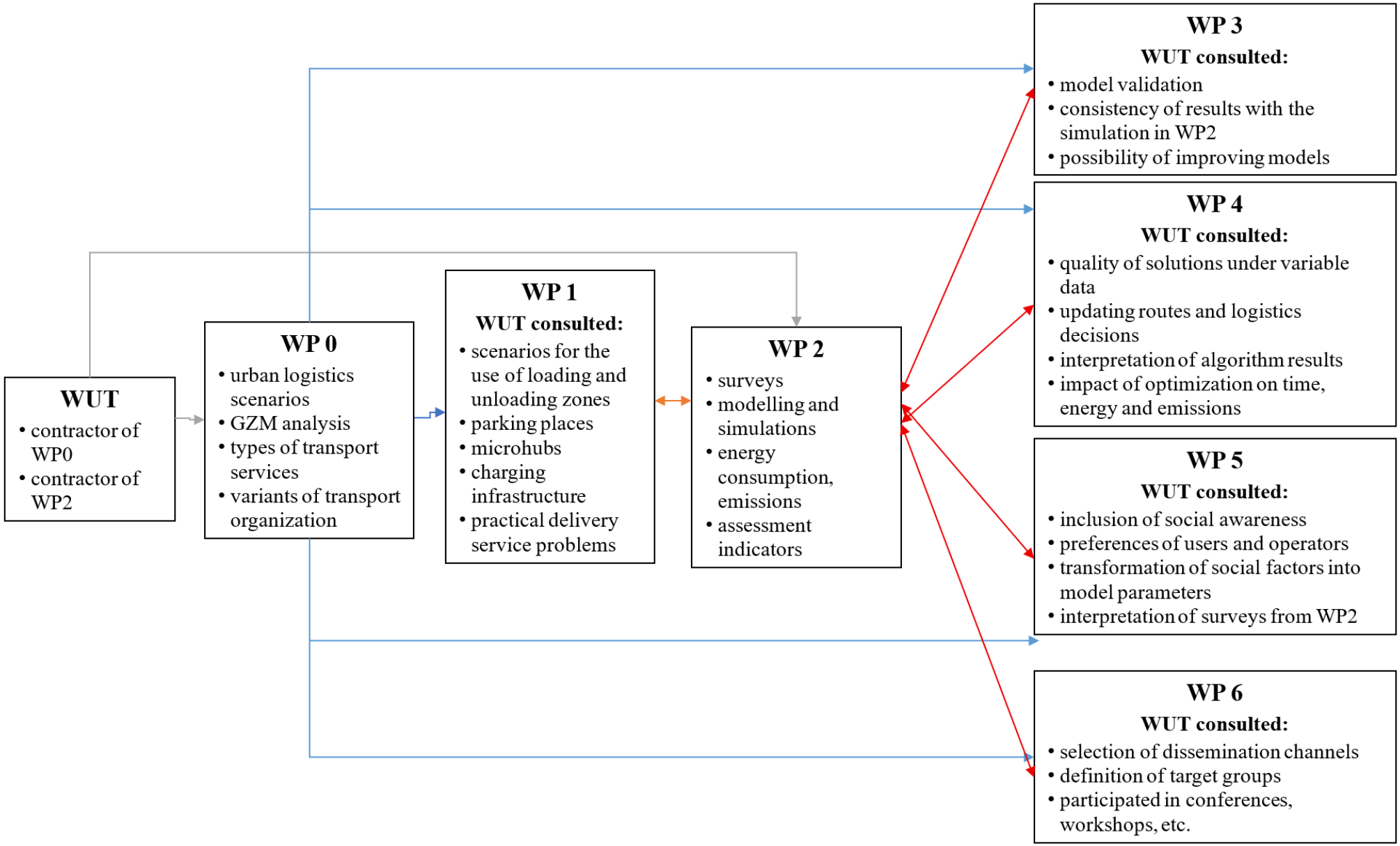

Fig. 1. Schematic representation of WUT's contribution to the implementation of tasks by foreign partners