Acceptance is in the Eye of the Stakeholder

Gathering the Needs for Automated Road Transport Logistics

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ABSTRACT

The transport logistics sector is expected to be a promising ground for the roll-out and business integration of automated vehicles. Within this transition towards driverless vehicles, fleet management and control interventions will have to be taken over by logistics personnel. However, so far, a specific needs and expectations analysis with regard to the involved stakeholders towards automated road transport logistics have only been analyzed to a limited degree, and consequently there is so far no systematic approach towards designing corresponding user interfaces. This demo video highlights the requirements gathering activities within the project AWARD, which investigates and develops all-weather autonomous real logistics operations and demonstrations. The demo video introduces into the different perspectives of the involved stakeholder groups, and it illustrates addressed use cases and operational scenarios. The derived acceptance factors model and first impressions of preliminary results are provided.

CCS CONCEPTS

• CCS; • **Human-centered computing**; • **Human computer interaction (HCI)**; • **Empirical studies in HCI**;

KEYWORDS

automated vehicles, requirements gathering, automated road transport logistics, technology acceptance model

1 INTRODUCTION

Currently, automation is implemented in many domains. Lots of respective efforts are being made in automated driving and workplace

environments [3] [4]. For a long time, this trend had an effect in the logistics area [1]. Already now, automated loading or warehouse management systems are in operation in many specialized areas, increasingly featuring automated guided vehicles (AGV) which do not have any human driver or passenger on board [6]. However, these AGVs have so far been restricted to operation on predefined routes, and they have limited abilities to adapt to new situations.

With the integration of more flexible driverless technology, automated vehicle fleets are expected to grow and will thus also transform the human workplace. While the role of the driver will get less important, other work models will have to be defined, in order to enable the qualified and responsible operation of the vehicle fleet. This especially includes the supervisory control of increasingly automated functions, as well as novel human-computer interaction (HCI) features for teleoperation and fleet management [11]. However, so far we do not know who will actually be the future operators of these future automated logistics fleet interactions, and what their requirements are. In order to come up with a valid specification of user requirements for human intervention, fleet management and teleoperation, it is important to take a comprehensive perspective, which also incorporates workplace requirements, economic and regulatory considerations.

Except for preliminary research [4], so far, few efforts have been made towards such a systematic and comprehensive level of understanding of the requirements for the operation of automated road transport logistics (ARTL). The European research and development project AWARD[1] has set out to close this gap. Within AWARD, 29 leading institutions develop and deploy efficient and safe connected and automated heavy-duty vehicles in real-life logistics operations. The requirements of a range of real-world applications and different types of dedicated vehicles and prototypes of fleet management systems are being investigated. The insights that are gained from real-world operations shall support the validation of solutions with regard to efficiency, availability, functional safety, scalability, or cost-benefits for hub operators or fleets. In order to demonstrate and evaluate the improvements for all-weather operation of automated vehicles, the AWARD concept includes four specific real-world use cases, which address vehicle tasks in different settings, from operational area to public roadways as well as with different automated vehicles and stakeholder constellations.

This paper and the accompanying video demo highlights key activities within this process of stakeholder requirements analysis. Section 2 presents a taxonomy of ARTL stakeholders and section 3

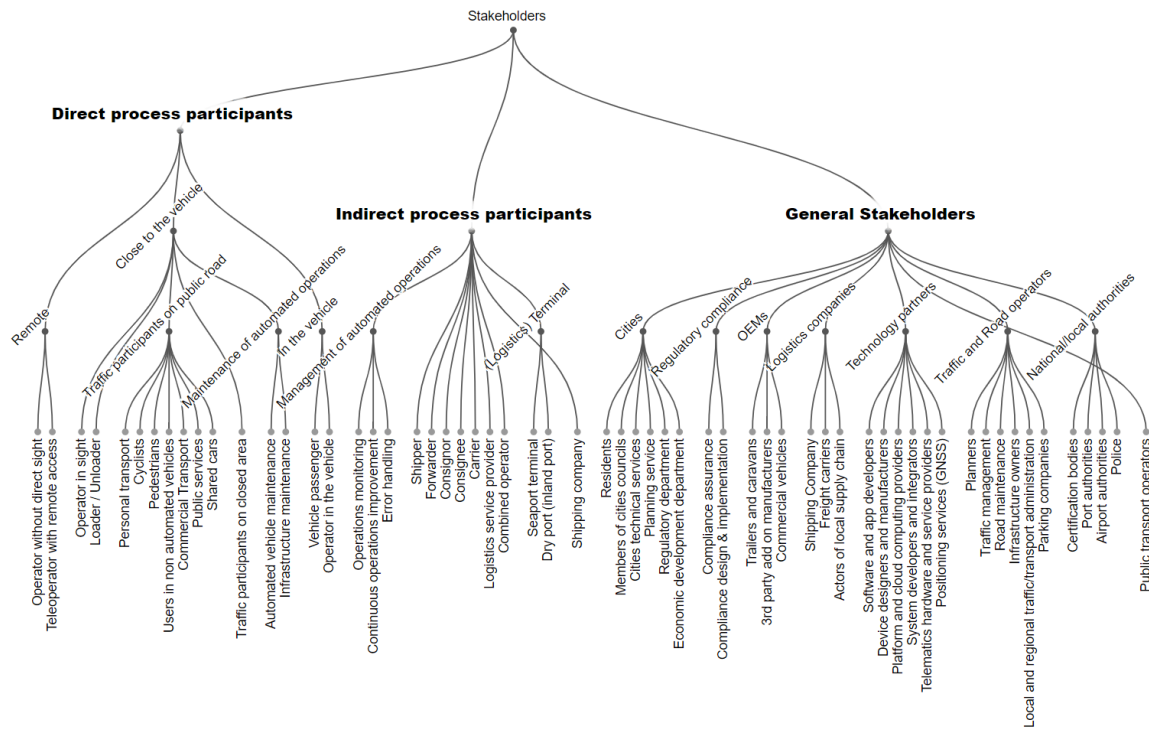[1]H2020 Project AWARD: www.award-h2020.eu

Figure 1: Stakeholder Taxonomy for automated road transport logistics [10]

then summarizes the different methods of capturing requirements data. Section 4 shows a framework in which the different aspects are incorporated to gain an integrative view.

2 DIFFERENTIATING STAKEHOLDER PERSPECTIVES

Figure 1 illustrates the stakeholder taxonomy that originated from discussions among ARTL experts from the AWARD project's 29 partners. The taxonomy consists of three main groups. We classify all persons who directly get in touch with or who are affected by automated vehicles a "direct process participants". These persons are remotely managing the vehicles (staff), working close to the vehicle at a production site or a logistics hub, or other public road users. From a human–computer interaction (HCI) point of view, this group is considered most relevant due to the direct interaction between the human operators and the technology. In order to be able to discuss the requirements for logistics processes in a holistic way, "indirect process participants" represent those who are not in direct contact with an automated vehicle. Finally, persons and institutions are clustered who are assumed to have an overarching interest in ARTL from an economic or social perspective ("general stakeholders").

## 3 MULTIPLE-VIEW REQUIREMENTS INQUIRY

The challenges of the ARTL requirements analysis are addressed by means of an empirical requirements data collection, incorporating

stakeholders, operations, and expectations perspectives. A mixed-methods approach is used to acquire the data required to learn about the ARTLAM related factors. On the one hand, this procedure shall allow for quantitative modelling of expectations factors across different stakeholder groups. On the other hand, it shall enable deep insights into the requirements of future automated logistics workplaces. Direct process participants are involved in contextual inquiry studies at the individual use case test sites (e.g., hub-to-hub logistics). Moreover, contextual interviews are carried out related to the ARTLAM factors.

An electronic survey was created as to cover different regions and to represent a large number of users across stakeholder categories in addition to this in-depth research. The respondents select their corresponding stakeholder category and use case and answer the respective specific questions regarding the ARTLAM factors. In addition, expert workshops facilitate the discussion of needs and requirements among stakeholder group representatives.

4 GRASPING STAKEHOLDER ACCEPTANCE

Based on considerations outlined in more detail in Fröhlich et al [10], we have developed an automated road transport logistics acceptance model (ARTLAM), which should help to structure the information gathered in the different requirements capturing activities (Figure 2). The ARTLAM model is designed to comprehend different perspectives, thus does not purely focus on usage of a system, but also on its operation and its introduction. This way, also general stakeholders and experts and their more abstracted interests and views can be considered in this framework. Inspired by
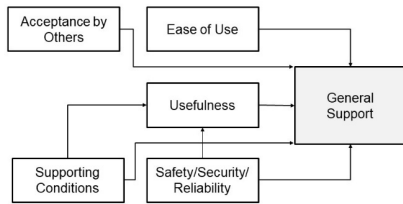
Figure 2: The Automated Road Transport Logistics Acceptance Model (ARTLAM) developed for the Requirements Analysis

the Technology Acceptance Model (TAM [2]), its successor models such as UTAUT [9], as well as application-specific models like the C-TAM [7] (see more details in Fröhlich et al [10]), the ARTLAM framework foresees "General Support" as more generic variant of "Willingness to Use".

This also includes the attitudes of the many stakeholders who do not directly use or are in contact with the vehicle in a given situation but may be affected in other ways. Taking this notion further, some standard dimensions known from TAM and UTAUT are applied, such as capturing usefulness and ease of use. Furthermore, the broader concepts of trustworthiness and facilitating conditions have been extended by safety and job relevancy, just as the findings from behavioral models that situations constraints highly affect adopting behaviors [5].

5 CONCLUSIONS

The success of the introduction of automated transport in logistics crucially depends on the acceptance of all involved stakeholders. The new requirements elicitation framework presented in this paper is based on a comprehensive stakeholder taxonomy, takes the operations perspective into account, and allows for qualitative and quantitative expectation capturing, both for human operators that are directly affected in their individual usage context and from a regional and societal point of view. A major expected benefit from this analysis is that the definition of user interface features for operators of highly automated transport logistics vehicles will be enabled. The suggested approach may not only supply a robust method for dealing with constraints regarding on-site exploration limitations due to the COVID-19 pandemic, but also provide the substrate for emerging new cross-media methods for collecting data that lead to contextual insights from virtual explorations of sites under investigation. From the analysis of the currently collected data, the proposed ARTLAM framework will be validated, and the approach will be refined.

ACKNOWLEDGMENTS

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