Software Traceability in the Automotive Domain: Challenges and Solutions

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Abstract: In the automotive domain, the development of all safety-critical systems has to comply with safety standards such as ISO 26262. These standards require established traceability, the ability to relate artifacts created during development of a system, to ensure resulting systems are well-tested and therefore safe. Our study [MSS18] contrasts general traceability challenges and solutions with those specific to the automotive domain, and investigates how they manifest in practice.
We combine a tertiary literature review to identify general challenges and solutions, a case study with an automotive supplier as validation for how challenges and solutions are experienced in practice, and a multi-vocal literature review to identify challenges and solutions specific to the automotive domain. We found 22 challenges and 16 unique solutions in the reviews. 17 challenges were identified in the case study; six remain unsolved. We discuss challenges and solutions from the perspectives of academia, tool vendors, consultants and users, and identify differences between scientific and "grey" literature. We discuss why challenges remain unsolved and propose solutions.
Our findings indicate that there is a significant overlap between general traceability challenges and those in the automotive domain but that they are experienced differently.

Keywords: Traceability, Automotive Software Engineering, Safety, ISO 26262, Automotive SPICE

In the automotive industry, traceability – the ability to relate artifacts created during the development of a system – is a necessity since safety standards require proof that safety requirements were specified, taken into account during the design and development, validated in test cases, and verified through safety analysis. In order to realize the benefits of traceability (and successfully argue their safety cases), software development companies need to establish a traceability strategy that is aligned with their goals. Defining and implementing a traceability strategy is not a trivial task, since it requires a good understanding of the artifacts to be traced as well as the ability to define meaningful links and to make sure the created links are useful.

The contribution of this paper is therefore to provide an exhaustive empirical evaluation of traceability challenges and solutions in the automotive domain that takes the specific characteristics of automotive software development into account. To achieve this, we conducted a tertiary literature review, a case study, and a multi-vocal literature review. This allows us to explore the traceability problem in the automotive domain from both the practical and the scientific perspective and provides insight into the challenges of traceability

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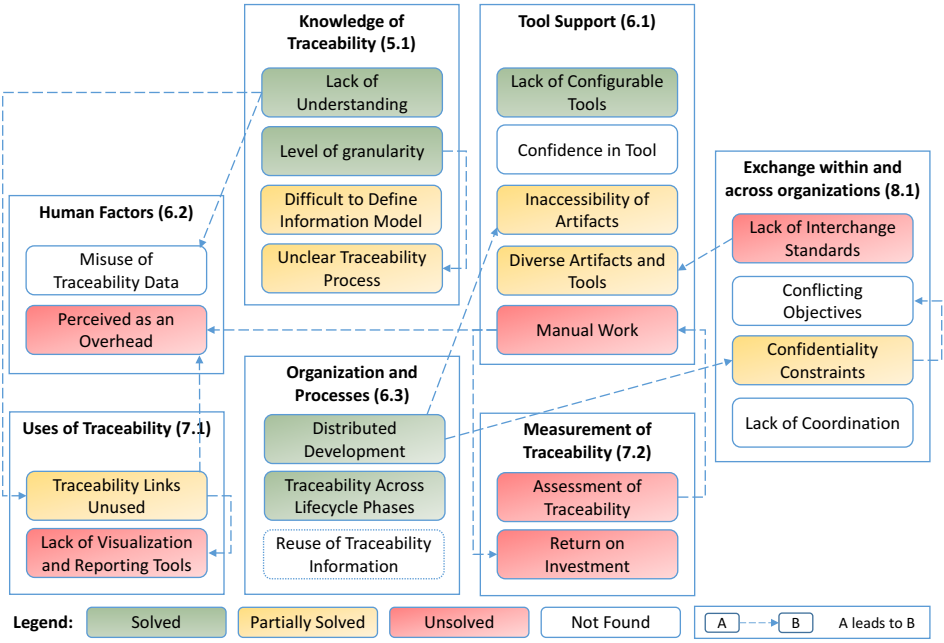

Fig. 1: Summary of Traceability Challenges. Challenges solved at the case company have a green background, partially solved challenges have a yellow background and unsolved challenges have a red background. Challenges that have no background color were only in the literature and not identified in the case study. Directed arrows indicate that one challenge leads to the presence of another one.

as they present themselves in practice as well as solution approaches proposed by academia, tool vendors, consultants, and the users of traceability themselves.

Our study shows that there is a significant overlap between general traceability challenges and solutions and those found in the automotive domain (Figure 1 provides an overview). It provides evidence that many solutions proposed in the literature are not applicable in the automotive domain due to its specific set of characteristics, such as system complexity, the safety-criticality of the developed systems, and the distributed development split between the OEMs and suppliers. While the tertiary review revealed challenges and solutions mostly from academia, the MLR was a richer data source that gave insight into practical problems. The case study validated our findings as most of the challenges were found there as well.

References

[MSS18] Maro, Salome; Steghöfer, Jan-Philipp; Staron, Miroslaw: Software Traceability in the Automotive Domain: Challenges and Solutions. In: Journal of Systems and Software Volume 141, July 2018, pp 85–110. https://doi.org/10.1016/j.jss.2018.03.060