

CRIT

Public report

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Fordonstrategisk
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FFI in short

FFI, Strategic Vehicle Research and Innovation, is a joint program between the state and the automotive industry running since 2009. FFI promotes and finances research and innovation to sustainable road transport.

For more information: www.ffisweden.se

1. Summary

Certification of safety-critical systems is essential in industries such as aerospace, automotive, medical devices, and nuclear energy. However, existing certification processes are complex and resource-intensive, making them difficult for small and medium-sized companies to adopt. This pre-study addresses this challenge by exploring more cost- and resource-efficient certification alternatives based on safety-critical functions implemented in the Rust programming language, which provides strong guarantees for memory safety and well-defined behaviour.

The project focuses on identifying the process and tool requirements needed for Rust-based development to meet the certification criteria defined by ISO 26262 (ASIL levels A–D). The outcomes of the pre-study form a solid foundation for a future full-scale FFI pilot project, where traditional C-based certification approaches will be implemented and compared with the proposed Rust-based alternative. Through this progression, the work advances from basic research and feasibility studies (TRL 1–3) toward technology demonstration in an industrial context (TRL 6).

The pre-study aligns closely with the FFI Roadmap 2030, particularly within the FFI Transport and Mobility Services and FFI Accelerate sub-programmes. By targeting a production-oriented automotive Electronic Control Unit (ECU) platform that integrates both established and emerging development approaches, the project addresses key challenges related to safety, efficiency, sustainability, and software complexity in modern vehicle systems. The work emphasizes industrial relevance, reuse of existing technologies in new contexts, and innovation with clear applicability, thereby lowering entry barriers for smaller actors and strengthening the competitiveness of the Swedish automotive and automation ecosystem.

In addition to the technical outcomes, the project has successfully built a growing network of industrial and research stakeholders interested in the research question. Dissemination activities, including conference publications and presentations, have generated interest and valuable contacts that are expected to play a critical role in shaping a strong consortium for a future full-scale FFI application. This network-building effort is an important enabler for continued collaboration and long-term impact.

2. Sammanfattning på svenska

Certifiering av säkerhetskritiska system är avgörande inom branscher som flyg, fordonsindustri, medicinteknik och kärnkraft. Samtidigt är dagens certifieringsprocesser komplexa och resurskrävande, vilket gör dem svåra att tillämpa för små och medelstora företag. Denna förstudie adresserar denna utmaning genom att undersöka mer kostnads- och resurseffektiva alternativ för certifiering, baserade på säkerhetskritiska funktioner

implementerade i programmeringsspråket Rust, som erbjuder starka garantier för minnessäkerhet och väldefinierat beteende.

Projektet fokuserar på att identifiera de process- och verktygskrav som krävs för Rust-baserad utveckling för att uppfylla certifieringskraven enligt ISO 26262 (ASIL-nivåerna A–D). Resultaten från förstudien utgör en stabil grund för ett framtida fullskaligt FFI-pilotprojekt, där traditionella C-baserade certifieringsmetoder kommer att implementeras och jämföras med den föreslagna Rust-baserade ansatsen. Genom detta arbete sker en förflyttning från grundläggande forskning och genomförbarhetsstudier (TRL 1–3) till teknologidemonstration i industriell miljö (TRL 6).

Förstudien är väl i linje med FFI Roadmap 2030, särskilt inom delprogrammen FFI Transport och Mobilitetstjänster samt FFI Accelerate. Genom att rikta in sig på en produktionsnära elektronisk styrenhetsplattform (ECU) för fordonsapplikationer, som integrerar både etablerade och nya utvecklingsmetoder, adresserar projektet centrala utmaningar kopplade till säkerhet, effektivitet, hållbarhet och ökande mjukvarukomplexitet i moderna fordonssystem. Arbetet betonar industriell relevans, återanvändning av befintliga teknologier i nya sammanhang samt innovation med tydlig tillämpbarhet, vilket sänker inträdesbarriärer för mindre aktörer och stärker konkurrenskraften inom det svenska fordons- och automationsekosystemet.

Utöver de tekniska resultaten har projektet även bidragit till att etablera ett växande nätverk av industriella och akademiska aktörer med intresse för forskningsfrågan. Genom spridningsinsatser, inklusive konferenspublikationer och presentationer, har projektet skapat ökat intresse och värdefulla kontakter som förväntas spela en central roll i utformningen av ett starkt konsortium inför en framtida fullskalig FFI-ansökan. Detta nätverksbyggande utgör en viktig möjliggörare för fortsatt samarbete och långsiktig påverkan.

3. Background

The Rust programming language has seen rapid growth in both community adoption and industrial interest, particularly for use in safety- and mission-critical systems. This has led to increased efforts to port legacy systems to Rust and to apply Rust-based solutions in both prototyping and production environments. Within the automotive sector, Swedish industry has taken a leading role. Volvo Cars has introduced Rust-based development in its SPA-2 ECU platform, now in production for vehicles such as the Volvo EX90 and Polestar 3. While current implementations focus on mission-critical but non-safety-critical subsystems, they demonstrate the industrial maturity and feasibility of Rust in embedded automotive contexts.

In parallel, international momentum for Rust in safety-critical applications is growing, supported by large industrial actors through initiatives such as the Safety-Critical Rust Consortium. Since 2024, the Rust toolchain has been qualified for use in safety-critical

development according to ISO 26262 (ASIL A–D), enabling commercial use. Despite this progress, certification of safety-critical systems remains complex, time-consuming, and costly, making it challenging not only for small and medium-sized enterprises but also for large companies. This creates a strong need for simplified and more cost-efficient certification approaches that can broaden industrial participation while maintaining high safety standards.

4. Purpose, research questions and method

The purpose is to lower certification costs of safety critical systems, specifically for small players in the field. Small companies can quickly be overwhelmed with the technical and bureaucratic burden that comes with traditional certification methods, thus excluding them as competitive players in the market.

The main research question is to identify and explore challenges to meet certification requirements from ISO 26262. The methodology adopted has been a mix of literature studies, discussions with key stakeholders and practical tools development as proof of concepts.

5. Objective

The objectives of the call can be summarized as:

1. Explore cost and resource efficient alternatives for certification to safety standards
2. Identify the requirements for Rust based development regarding processes and tools for meeting the certification criteria for ISO 26262
3. Full application for a larger full-scale FFI pilot project to be submitted in the autumn 2025
 - a. As subgoal for this the creation of a wider group of interested industry and academic partners will be great

6. Results and deliverables

We believe we have completed the scope of the project. Our goal was to focus on the certification process and show how Rust-based approaches could be a valid alternative to traditional certification processes. The current process for certification of safety critical

system is cumbersome and expensive, therefore only accessible to big companies. The possibility of a cheaper and more cost-efficient alternative would allow small companies to achieve safety critical system certification with the benefit of new technologies, tools, and the establishment as new players in the market. We had in our plan to contribute to the research and work towards a full FFI project application and submit that in the Safe Traffic Automation – FFI – Autumn 2025 call. Both these were completed, and a full application was written and submitted.

Even though the application was not granted funding, we believe that the goal was completed. We believe that the consortium presented was not sufficient to justify a project as it included a single small company and only one letter of interest from big industry players. This leaves us with the intention to try to continue building the right consortium and get a definitive commitment from those big industry partners (Volvo, Scania, other). While the timing was not right for this call, due to the current uncertainties in the automotive sector, we believe the goal and research question to be very important and relevant in the future years.

Further, and this can be seen as a research outcome as well, have we covered the interplay between safety critical aspects and the ever more emerging security requirements due to increased connectivity. The combination of these challenges calls for strong programming foundations (such as type and memory safety and strong guarantees to defined behaviour) which may be delivered by Rust and accompanying tooling for safety and security certification.

7. Dissemination and publications

7.1 Dissemination

How are the project results planned to be used and disseminated?	Mark with X	Comment
Increase knowledge in the field	X	Workshop and conference attendance.
Be passed on to other advanced technological development projects	X	Early results have been used in education at LTU, used in product development at Grepit, and as background material for future research applications.
Be passed on to product development projects	X	See above.
Introduced on the market	X	Not yet mature/ready for wider industrial uptake.
Used in investigations / regulatory / licensing / political decisions	X	Not applicable.

7.2 Publications

Munch, M., Lindner, M., Eriksson, J., Dzialo, P., & Lindgren, P. (2025). Rust for Safety and Security Critical Systems. 2025 IEEE Nordic Circuits and Systems Conference (NorCAS), Proceedings in IEEE Xplore. Presented at the 2025 IEEE Nordic Circuits and Systems Conference (NORCAS), Riga, Latvia, 28-29 October, 2025.
<https://doi.org/10.1109/norcas66540.2025.11231205>

8. Conclusions and future research

The work done in this project encountered a negative decision to move directly to the full project application. We believe that this outcome is not due to the research question and the background needs of the project. The potential and long-term effect are vital and will be important for the Swedish industry market in the coming years. However, in our application we could not obtain the concrete partnership from big industry, we only obtained a strong interest. This is due to the high uncertainties of the automotive sectors and the hard economic situation that some big companies in Sweden have seen in 2025. While the timing for them is wrong we believe the research question is still of high relevance for them and we will continue to create such consortium and apply in the future for FFI grants. We believe this project to be well aligned with the FFI Agenda for 2030, particularly within the sub-programmes *FFI Transport and Mobility Services* and *FFI Accelerate*.

9. Participating parties and contact persons

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