

AutoPercept AI: Pioneering Intelligent Agents in Automotive Design and Engineering

Public report

Project within 2024-03982

Author Kostas Stylidis

Date 2025-03-20



Fordonsstrategisk
Forskning och
Innovation

Content

1. Summary	3
2. Sammanfattning på svenska	3
3. Background.....	4
4. Purpose, research questions and method	5
5. Objective.....	6
6. Results and deliverables.....	7
7. Dissemination and publications.....	10
7.1 Dissemination	10

7.2 Publications	11
8. Conclusions and future research	11
9. Participating parties and contact persons	12

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

Intended Future is a deep-tech startup, part of the CampX by Volvo Group Incubator, developing intelligent agents for industrial needs. Over the course of this 3-month Vinnova - FFI project (2024-03982), we aimed to build a functional MVP of the Perceived Quality (PQ) AI Agent—internally known as **Agent Q**. We succeeded in delivering not just an MVP but an early-stage professional software (SaaS) product that assists designers and engineers in making data-informed decisions about perceived quality.

Key Achievements

- **Speed and Accuracy:** Reduced manual efforts through automated data analysis and real-time feedback loops, saving design teams hundreds of hours.
- **Product Quality Control by the use of Machine Vision:**
- **Market Intelligence Integration:** Leveraged global user insights to inform design decisions, ensuring alignment with customer expectations.
- **Transparent Methodology:** Every AI-driven recommendation is grounded in real user data, avoiding “black box” solutions and unlocking deeper user understanding.
- **Perceived Quality Quadrant:** A unique benchmarking tool that immediately highlights design attributes in need of attention, balancing craftsmanship (execution/deviation from design intent) and customer impressions (importance of attributes).

By applying Agent Q, automotive stakeholders can identify design issues early, implement sustainable solutions, and optimize user satisfaction—ultimately lowering development costs and accelerating time-to-market. Additionally, Agent Q’s success lays the groundwork for further intelligent agent development across Volvo Group.

2. Sammanfattning på svenska

Under projektet AutoPercept AI har Intended Future, i samarbete med Volvo Technology och andra industripartner, utvecklat Agent Q – en AI-baserad mjukvaruagent för att förbättra och påskynda designbeslut kring upplevd kvalitet i fordonsindustrin. Genom att kombinera avancerad teknik som Retrieval-Augmented Generation (RAG), knowledge graphs (KG) och användardata i realtid, har Agent Q potential att förkorta utvecklingscykler, minska kostnader och stärka hållbarheten i produktionen.

Projektets fokus var att ta fram en MVP (Minimum Viable Product) som skulle analysera och visualisera kritiska kvalitetsparametrar (till exempel hantverksskicklighet, materialanvändning och kundintryck) i syfte att både höja produktkvaliteten och förbättra samarbetet mellan design, teknik och tillverkning. Resultaten visar att verktyget effektivt

automatiserar annars tidskrävande manuell granskning, vilket frigör resurser och främjar datadrivna beslut i ett tidigt skede av fordonets utveckling.

För att uppnå dessa mål utgick projektet från en Perceived Quality Framework (PQF), utvecklad vid Chalmers och testad inom olika OEM-sammanhang. Denna ramverk, kombinerad med maskininlärning och industriellt kunskap, gav projektgruppen en strukturerad metod för att knyta samman tekniska krav med användarupplevelse. Projektet uppfyllde sina huvudsakliga mål utan negativa avvikelser, och flera funktioner—bland annat avancerad dataanalys och användarfeedback—infördes till och med tidigare än planerat.

Agent Q:s framgång öppnar dörren för framtida tillämpningar: i närtid planeras en SaaS-lansering under 2025 där mindre OEM-företag och utbildningsinstitutioner kan ta del av analysplattformen utan att själva utveckla dyra speciallösningar. Därigenom demokratiseras kunskapen om upplevd kvalitet, vilket påskyndar innovation och samarbete i branschen. Dessutom diskuteras nästa steg i form av DigitalDriver AI, som ska emulera förarbeteende och därigenom ge snabb återkoppling kring ergonomi, säkerhet och förarmiljö. Sammantaget bidrar projektet till FFI:s målsättningar genom att stärka svensk fordonsindustri med resurseffektiva, hållbara och digitalt transformerade arbetsprocesser—ett steg framåt mot framtidens konkurrenskraftiga och klimatsmarta mobilitetslösningar.

3. Background

The Swedish automotive industry faces increasing demands for higher perceived quality to stay competitive and fulfill customer expectations. Perceived Quality (PQ) directly influences consumer purchasing decisions, brand loyalty, and overall market performance, as customers often judge a vehicle's craftsmanship, materials, and design execution as markers of its overall excellence. However, conventional methods of evaluating workmanship, fit-and-finish, and aesthetic appeal typically rely on labor-intensive, manual reviews, introducing significant subjectivity and prolonging development cycles. This situation not only drives up costs but can also dilute design consistency and hamper the rapid market introduction of new vehicles.

PQ itself is often considered a “secret recipe” for product success—a form of specialized knowledge that leading automakers treat as proprietary. Effective management of PQ encompasses balancing intangible user impressions with engineering metrics. To bridge this gap, Intended Future has developed strategic decision-making tools, such as the Perceived Quality Index and the Customer Acceptance Index™, which have demonstrated substantial benefits in multiple OEM contexts. Building on these capabilities, the idea of an AI-driven solution emerged as a powerful way to integrate best practices, industry standards, and real-time user feedback into everyday design processes.

An AI Agent—particularly one utilizing retrieval-augmented generation (RAG) and knowledge graphs (KG) - can address many of the core issues tied to subjective and time-consuming PQ assessments. By automating parts of the evaluation and integrating actual user data, such an agent reduces reliance on manual processes and helps ensure that key factors like workmanship, styling alignment, and user-experience data are consistently taken into account. Designers and engineers gain immediate feedback on critical design attributes, enabling them to refine concepts more efficiently and minimize costly iteration loops. Consequently, harnessing AI in perceived quality assessment not only speeds up development but also standardizes and enriches the decision-making process, fostering higher-quality products that resonate with end users.

Through this approach, it becomes possible to pinpoint design risks earlier, adopt more sustainable production methods, and systematically incorporate the evolving preferences of a global automotive market. In a sector where minor details can set one brand apart from another, ensuring high perceived quality at every level can significantly influence customer satisfaction, loyalty, and overall business performance. AI Agents thus represent both a technological leap forward and a strategic enabler for automotive companies intent on meeting evolving consumer demands and maintaining a competitive edge.

In parallel, the AutoPercept AI project was conceived to validate the feasibility of deploying such intelligent agents within industrial environments at Volvo Technology. By emphasizing a robust data infrastructure, user-friendly interface design, and rigorous system testing, the project aimed to ensure that any AI-driven solutions developed under this framework would align with real-world operational requirements, effectively bridging the gap between research concepts and enterprise-level applications.

4. Purpose, research questions and method

Purpose

The overarching goal was to develop an AI-driven software agent (MVP) capable of providing information for strategic automotive design decisions, focusing on perceived quality. This effort would also validate the feasibility of leveraging data-driven insights to reduce design cycles and improve overall product acceptance.

Research Questions

- How can AI Agent reduce design iteration cycles while maintaining or improving perceived quality?
- Which metrics best capture both craftsmanship and user impressions for a holistic view of automotive design execution?

- Can real user feedback be integrated in near real-time without overwhelming design and engineering teams?

Method

- Perceived Quality Framework (PQF) as Underlying Methodology
Served as the foundation for identifying and categorizing the critical design variables that influence craftsmanship execution and user-perceived product impression. PQF provides a structured way to assess quality attributes at both tactile and visual levels, ensuring a common reference point for both engineers and end users. (See: Styliadis, K., Wickman, C., & Söderberg, R. (2020). Perceived quality of products: a framework and attributes ranking method. *Journal of Engineering Design*, 31(1), 37–67.)
- Retrieval-Augmented Generation (RAG): Merged relevant industry knowledge with user feedback using an LLM-based system.
- Created Knowledge Graphs (KG) capturing a complete logic of Perceived Quality Framework and its attributes interrelations.
- Rapid Prototyping & Iterative Development: Deployed an interactive interface and prompt-engineering framework that supports both textual and visual feedback.

5. Objective

Originally, the primary objective outlined in the project application was to develop a robust MVP of the Perceived Quality (PQ) AI Agent—internally known as Agent Q—that could dramatically shorten automotive design iteration cycles while maintaining or improving perceived quality. Specifically, we proposed leveraging data-driven insights to (1) reduce design loops by approximately 30%, (2) lower overall product development costs by around 15%, and (3) improve customer satisfaction by as much as 20%. These targets were to be achieved by integrating advanced AI features—such as Retrieval-Augmented Generation (RAG) and knowledge graphs—into a user-friendly software demonstrator that designers and engineers could use to make early, accurate assessments of perceived quality.

In practical terms, we aimed to build an intelligent companion that processes both text and image data from standard mobile or desktop devices. This companion would offer near-instant feedback on workmanship, materials, fit-and-finish, and other visual or tactile cues critical to shaping positive user impressions. By consolidating industry best practices, recognized quality standards, and user feedback, Agent Q was expected to reduce manual evaluations, illuminate critical design issues earlier in the process, and better align end products with evolving customer expectations.

Changes to Objectives

No major changes were made to these core objectives; rather, we delivered on our commitment to create an AI-driven MVP capable of real-time, data-informed quality assessments. While certain secondary features—such as advanced analytics and integration with external market intelligence—were added earlier than planned, these enhancements remained consistent with the overarching goal of building an industrially deployable, AI-driven solution for perceived quality. Thus, the original vision to shorten development cycles, optimize product quality, and boost user satisfaction was upheld throughout the course of the project.

6. Results and deliverables

The project successfully delivered a fully functional MVP of the Perceived Quality (PQ) AI Agent—internally referred to as Agent Q—surpassing its original roadmap. By blending retrieval-augmented generation, knowledge graphs, and real user feedback, the MVP evolved into a professional-grade software tool capable of analyzing key design attributes in real-time. The results and deliverables contribute directly to FFI's commitment to accelerate innovative, cost-efficient, and sustainable mobility solutions.

Specifically:

- **Efficient Design Iterations:** Agent Q automates the detection of deviation from design intent in materials, workmanship, and user impressions. This capability significantly reduces the time and resources typically devoted to manual reviews, aligning with FFI's aim of bolstering global competitiveness in the Swedish automotive sector.
- **Data-Driven Decision Support:** By focusing on measurable parameters rooted in real user data, Agent Q empowers design and engineering teams to fine-tune concepts early in the product life cycle. This fosters deeper cross-functional collaboration and supports FFI's push for advanced digitalization in the automotive industry.
- **Sustainability Gains:** Early detection of design risks promotes eco-friendly choices and the avoidance of wasteful rework. Incorporating sustainability metrics at the design stage also helps meet FFI targets related to circularity, zero emissions, and more resource-efficient development.
- **Stable Codebase and Documented Architecture:** A well-structured GitHub repository and system-level documentation lowers the barriers for future enhancements and broader adoption. This outcome strengthens FFI's objective of creating open yet secure platforms that can be scaled and commercialized.

Educational Potential:

As we prepare Agent Q for a public SaaS launch in April 2025, smaller OEMs and academic institutions will gain streamlined access to advanced perceived quality knowledge without the complexity of a custom-built solution. By democratizing perceived

quality know-how, the project fosters innovation within the broader automotive ecosystem and enriches academic research, bridging the gap between classroom theory and cutting-edge industry practices.

Perceived Quality Quadrant

Visual Benchmarking: An analytics tool plots craftsmanship (vertical axis) against customer impressions (horizontal axis). This instantly highlights attributes that need attention—whether due to poor execution or high user importance.

Actionable Insights: The quadrant has proven to be more intuitive than conventional design reviews, allowing teams to rapidly prioritize corrective actions.

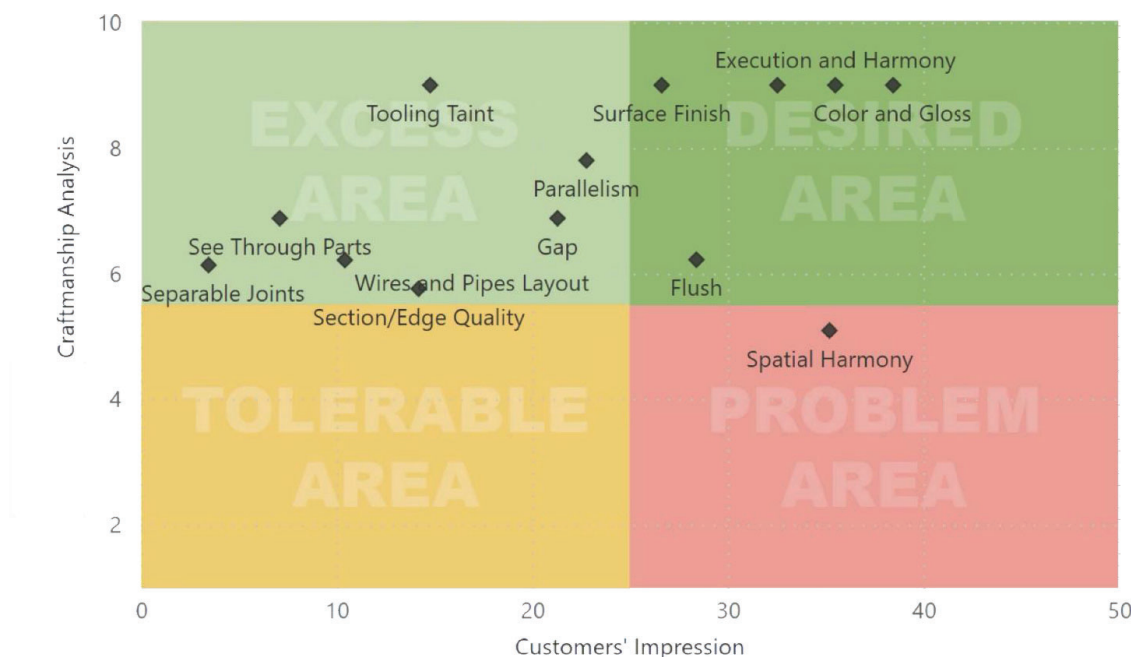


Figure 1. Perceived Quality Quadrant

Deviations:

- **Positive Deviations:** The project integrated advanced analytics and expanded user feedback loops sooner than anticipated. These additional features enriched the AI's benchmarking capabilities and enhanced data clarity for designers, yielding faster value creation than initially planned.
- **No Negative Deviations:** All major milestones were delivered within the set timelines and budget constraints. The absence of adverse deviations underscores efficient resource utilization and stable project management, aligning with FFI's emphasis on high-impact, results-driven execution.

Public SaaS Release (April 2025)

- We intend to release Agent Q as a Software-as-a-Service (SaaS) platform, making advanced perceived quality analytics available to a wider audience, including smaller OEMs, tier suppliers, academic institutions, and student teams in design competitions.
- By offering an accessible subscription model, we democratize perceived quality knowledge and encourage broader experimentation and innovation in automotive design.

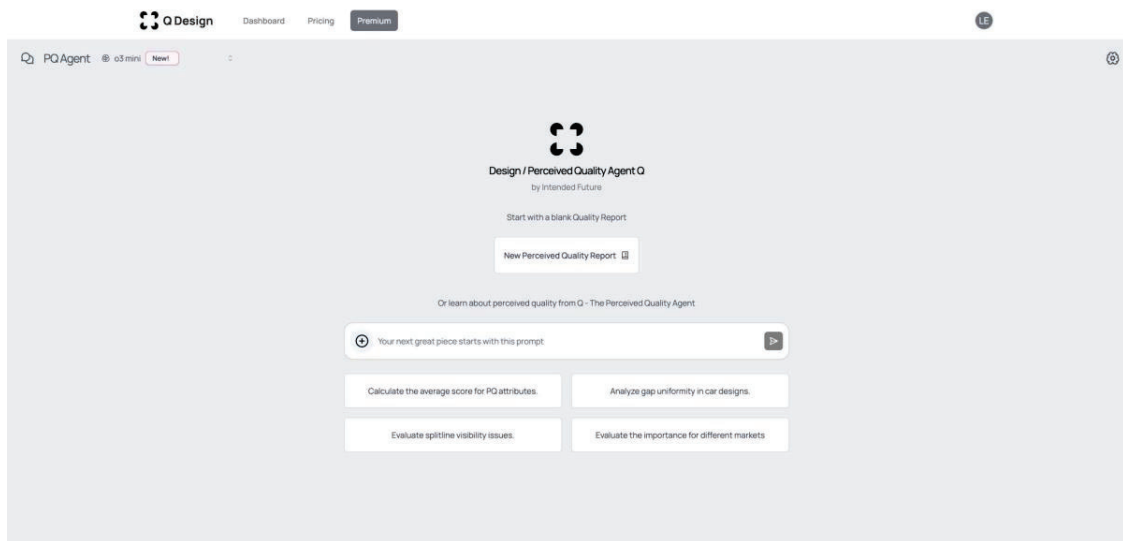


Figure 2. Backend Agent Q prototype

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	Shared knowledge within Volvo Group Design, potential cross-department collaborations
Be passed on to other advanced technological development projects	x	Foundations used for next-level AI-driven solutions (RAG, Vector Databases, Knowledge Graphs) will be applied in the next planned project supported by Volvo Technology AB
Be passed on to product development projects	x	With additional security layer MVP can transition into projects across Volvo Group design/engineering/product planning/market intelligence teams
Introduced on the market	x	Test pilot rollouts in April 2025, subject to user feedback and final refinements
Used in investigations / regulatory / licensing / political decisions	x	Used as a case for the EU Commission RG COP Industry 5.0 Will influence EU level policy making related to the Industry 5.0

DigitalDriver AI (Planned Future Project): The success of Agent Q informs a joint with Volvo Technology long-term vision of developing an AI agent that can emulate real truck driver behaviors. While DigitalDriver AI is not yet designed, this future concept would leverage lessons learned in Agent Q to deliver rapid, accurate feedback for Volvo Group's product development.

Support from Volvo Technology

- We have received full support from Volvo Group Design to explore and co-develop a follow-up phase, focused on enhancing the driver persona aspect. This sets the stage for future project, which will integrate driver behavioral emulation into design decisions.
- The confidence shown by Volvo Group Design underscores the potential impact of Agent Q on broader design, user experience, and inclusivity considerations.

Through these objectives, we plan to bridge knowledge gaps across the industry, fostering innovation and collaboration at multiple levels.

Wingquist Laboratory 24th Annual Seminar, Chalmers University of Technology

Presentation of the project at [Wingquist Laboratory 24th Annual Seminar](#) on Digital Product Realization on April 8th, 2025

7.2 Publications

Blog posts and Intended Future's [LinkedIn Newsletter](#) articles. Research paper planned for 2025: "Agent Q: AI-Driven Perceived Quality Assessment in Automotive Engineering Design."

8. Conclusions and future research

The development and initial deployment of Agent Q have demonstrated that an AI-based tool, built on retrieval-augmented generation (RAG) principles with use of Knowledge Graphs (KG) built on methodology developed at Chalmers University of Technology (Perceived Quality Framework), can transform the way automotive designers and engineers evaluate and refine perceived quality.

By providing real-time feedback, benchmarking capabilities, and a user-friendly interface, the solution proved effective in reducing manual effort, shortening iteration cycles, and facilitating data-informed decisions. Although additional large-scale testing is necessary to fully quantify the precise cost and time savings, preliminary feedback from pilot users and internal trials shows promise in supporting design/engineering teams across multiple stages of product development.

One of the most notable achievements is the successful integration of both qualitative and quantitative data into a single platform that makes perceived quality more tangible for a wide range of stakeholders. Designers and engineers can now visualize how craftsmanship and customer impressions intersect, enabling them to prioritize perceived quality attributes that align with target user expectations and brand values. The collaboration with Volvo Group further demonstrated the underlying methodology flexibility, particularly in addressing diverse requirements across various teams, from design studios to market intelligence units. As a result, Agent Q has sparked broader interest, with several discussions underway about expanding its application to additional product lines and use cases.

In the immediate future, our focus will be on transitioning Agent Q from an internal pilot to a full-fledged Software-as-a-Service (SaaS) platform, aimed for release in April 2025. This move will open perceived quality analytics to a broader audience, including smaller OEMs, suppliers, and educational institutions. Such democratization accelerates industry-wide improvements in perceived quality and fosters cross-functional innovation, as even student design teams or independent researchers can tap into cutting-edge analytics once reserved for major corporations.

Beyond scaling the existing solution, the next major challenge involves extending the core concept of Agent Q to encompass driver behaviors and contextual insights. Together with Volvo Group Design, we aim to explore the creation of a specialized “DigitalDriver AI,” which would integrate user acceptance studies, real-world data on driver habits, and advanced modeling techniques to further enhance product design, safety features, and cabin comfort. While this proposed follow-up project is still in the drafting phase, the lessons learned from Agent Q—particularly in prompt engineering, knowledge-base curation, and rapid user testing—will be instrumental in shaping its development roadmap.

In parallel, there is significant potential for adding life cycle assessment (LCA) metrics and regulatory guidance into Agent Q, ensuring that sustainability and compliance remain at the forefront of design decisions. By incorporating data on material impact, carbon footprint, and evolving environmental regulations, Agent Q could help designers make more holistic decisions that balance user preferences, cost considerations, and ecological goals. Such enhancements could place Agent Q at the crossroads of cutting-edge AI research, industrial strategy, and societal demands for greener transportation solutions.

Overall, the achievements thus far confirm the feasibility and value of adopting an AI-driven methodology in evaluating perceived quality. As we evolve Agent Q into a full-scale SaaS offering and explore advanced applications, the project has the potential to influence how the automotive industry—and potentially adjacent sectors—blends user insights, technical rigor, and sustainability into the design process.

9. Participating parties and contact persons



Contact persons:

Kostas Stylidis (kostas@intendedfuture.ai)