



Guidelines for Designing User-Centered AI Agents for the Automotive Industry

Under the Hood of Creating an Interface to Support Perceived Quality Evaluation in Automotive Design

Master's Thesis in Industrial Design Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY

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Cover: Perceived Quality evaluation visualized in 3D, showcasing a vehicle on a
production line being assessed, with a digital interface concept of an AI agent in the
background

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Abstract

This thesis investigates the design of user-centered AI agents for the automotive industry with a focus on their application in Perceived Quality (PQ) evaluation support. It addresses the challenges faced by automotive designers, engineers, and decision-makers by exploring their workflows, needs, and barriers to AI adoption. Using a human-centered design approach, the research incorporates qualitative interviews and thematic analysis to understand current design processes and identify key concerns about integrating AI. The findings underscore the importance of trust, transparency, and collaboration, as well as the necessity of AI serving as a supportive tool rather than a replacement for human creativity. Based on these insights, nine actionable design guidelines are proposed to ensure that user-centered AI agents complement the workflows of decision-makers and designers while preserving their creative autonomy. Additionally, a high-fidelity prototype of a Perceived Quality AI agent was developed to demonstrate these guidelines in practice. This study contributes to the emerging field of human-centered AI design in industrial contexts. It also provides a foundation for future research to refine and validate the proposed design principles through user testing and further application not only in the automotive sector but also across other industries.

Keywords: design guidelines, user-centered design, interface design, designing AI Agents, perceived quality (PQ), automotive industry, automotive design.

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Victor Andersson, Martin Siljeklint
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List of Acronyms

Below is the list of terms that have been used throughout this thesis listed in alphabetical order:

AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
BWS	Best-Worst Scaling
CAI	Customer Acceptance Index
CMF	Color, Materials, Finish
DQ	Design Quality
EAA	European Accessibility Act
GDPR	General Data Protection Regulation
HCI	Human-Computer Interaction
HMI	Human-Machine Interaction
HRI	Human-Robot Interaction
ICT	Information and Communications Technology
IP	Intellectual Property
LLM	Large Language Model
OEM	Original Equipment Manufacturer
PQ	Perceived Quality
PQF	Perceived Quality Framework
QDA	Qualitative Data Analysis
R&D	Research and Development
RAG	Retrieval-Augmented Generation
ROI	Return on Investment
UCD	User-centered Design
UI	User Interface
UX	User Experience
WCAG	Web Content Accessibility Guidelines

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1

Introduction

Since the launch of OpenAI ChatGPT in 2022, generative AI has taken the world by storm (Willige, 2024). It is changing the way we work and live, with applications spanning education, healthcare, finance, and creative industries (Sharma, 2024).

The generative AI market has experienced rapid growth, increasing from \$11 billion in 2020, with projections over \$1.3 trillion by 2032 (Thormundsson, 2024a, 2024b), accounting for 10-12 percent of global tech spending (M. Singh and Rana, 2024).

The automotive industry is no exception, with AI influencing everything from manufacturing processes to research and design (Breunig et al., 2017). To remain competitive and meet consumer demands, automakers must identify key sources of value and develop analytical capabilities and an AI-ready culture (Breunig et al., 2017).

In particular, areas like Perceived Quality (PQ) and Color, Material, Finish (CMF) evaluation are now being explored for AI integration. In this context, the client Intended Future, is developing AI agents to reduce both time and costs, while enhancing consistency and insight for automakers (Intended Future, 2023).

For such AI agents to be successful and competitive, they must be designed with users in mind. As AI tools become more complex, the need for intuitive, user-centered interfaces becomes critical, not only to improve usability and decision-making but to ensure adoption by designers, engineers, and decision-makers accustomed to traditional workflows. This thesis investigates how to design user-centered AI agents for the automotive industry, with a focus on interfaces that support perceived quality evaluation. Through a human-centered design approach, based on qualitative interviews and thematic analysis, the study identifies users' workflows, challenges, and needs. The insights gathered inform the development of actionable design guidelines to aid the development of future AI agents within the automotive industry. An interface is proposed as the visual representation of the guidelines.

1.1 Aim

The aim of this project is to investigate how to design user-centered AI agents for the automotive industry. The study will identify the workflows, needs, and challenges faced by its primary users; designers, engineers, and decision-makers, to develop design guidelines. Furthermore, an intuitive and visually engaging interface proposal for a perceived quality evaluation AI tool will be designed to showcase the proposed guidelines in practice.

1.2 Research Questions

RQ: How can AI tools be designed in a user-centered way to support automotive professionals in their workflows and decision-making?

SQ1: What are the workflows and challenges experienced by designers, engineers, and decision-makers?

SQ2: How are AI tools currently applied within the automotive industry?

SQ3: What features and functions do automotive professionals require from AI tools, and how can interface design support these needs?

SQ4: What are the key barriers to the adoption of AI tools in the automotive industry, and how can they be addressed?

1.3 Limitations

This thesis explores how artificial intelligence can be meaningfully integrated into the workflows of automotive designers, with a particular focus on how AI tools can be designed to support this integration. Accordingly, the scope is limited to early-stage concept development, rather than technical implementation or performance evaluation. Long-term studies and large-scale user testing are beyond the timeframe and objectives of this project.

Additionally, the research is situated within the European automotive design context, with a particular focus on the Swedish automotive industry, and reflects the norms, tools, and cultural practices of that environment. In alignment with the client's request, the study will specifically target insights relevant to the domains of Perceived Quality and Color, Materials, and Finish (CMF). As such, the findings may not be directly transferable to other industries or geographic regions without contextual adaptation.

2

Background

This chapter provides the necessary background information for the thesis by first introducing the topic of Artificial Intelligence (section 2.1) with a focus on its use and impact on automotive design workflows. The subsequent presentation is of Intended Future (section 2.2), the company responsible for the development of the AI agent. Finally, it examines Perceived Quality (section 2.3), a fundamental concept of the AI agent, along with its related terms: Color, Material, and Finish (subsection 2.3.1) and Customer Acceptance Index (subsection 2.3.2).

2.1 Artificial Intelligence

Artificial Intelligence (AI) is a term coined by John McCarthy all the way back in 1955 (McCarthy et al., 2006), defining it as “the science and engineering of making intelligent machines, especially intelligent computer programs.” (McCarthy, 2007, p.2). Since then, AI has undergone multiple cycles of evolution, but the definition from 1955 is still relevant today. For example, The Oxford English Dictionary defines Artificial Intelligence as “The capacity of computers or other machines to exhibit or simulate intelligent behavior; the field of study concerned with this. In later use also: software used to perform tasks or produce output previously thought to require human intelligence, esp. by using machine learning to extrapolate from large collections of data.” (Oxford English Dictionary, 2023).

Around the time of its introduction, AI relied on rule-based systems that mimicked human reasoning. It lacked the ability to learn or adapt, which changed in the 1970s and 1980s when machine learning emerged, enabling computers to learn from data (Vashishth et al., 2023). Vashishth et al. (2023) explain that since the early 2010s AI has seen a major revival with deep learning, which uses neural networks to process large datasets, leading to implementation and advancements in sectors like healthcare, finance, and transportation, among others. With the introduction of

OpenAI ChatGPT in late 2022, generative AI has become a part of many people’s daily lives, changing the way we work, and helping us perform both mundane and complex tasks (Willige, 2024). The McKinsey Global Institute estimates that artificial intelligence has evolved to the degree that it “would be possible to automate at least 30 percent of activities in about 60 percent of occupations in both the United States and Germany”, and it will continue to evolve to be able to automate even more complex tasks in the future (Breunig et al., 2017, p.1).

2.1.1 AI in Automotive Design

Automotive designers work both independently and collaboratively, and to communicate their ideas, they have a diverse set of tools. Some designers prefer digital tools, while some prefer traditional sketches (Schenk, 2014). According to Tovey et al. (2003), sketches are essential modes of communication and play a key role in the development of automotive concepts.

Alongside image-based stimuli, textual stimuli often inspire concept design. Cues, like “bold” and “dynamic,” help set a clear direction, particularly in automotive design, where such terms have evolved to represent specific shapes and styles (Costa and Aguzzi, 2015). These cues can be communicated internally or externally among design teams, ensuring cohesive and consistent designs. However, this specific designer vocabulary is not widely recognized or used by most online users (Saadi et al., 2023), meaning that terms like “dynamic” can have a different meaning in design than on the internet, e.g. generative AI chatbots.

Still, the rise of generative AI techniques, with tools such as Midjourney, offers significant potential for professional and amateur designers and their design creations. However, their application in design contexts may present several challenges. Firstly, Cai et al. (2023) acknowledges that generative AI tools potentially limit creativity when producing visually similar content because of stylistic biases. Moreover, Regenwetter et al. (2022) highlights that generative tools often fail to grasp the specific context in which designers work. Their primary objective is to replicate patterns found in the training data, imitating existing designs rather than introducing innovative features.

In a similar study by Wang et al. (2024), it was found that automotive designers predominantly seek and develop inspiration through digital means and use AI-generated designs at a later stage as visual references for further development. Their study examines how expert designers utilize inspiration and generate concepts, empha-

sizing that professionals and amateurs may interact with AI differently. Therefore, understanding and integrating generative AI tools into professional design workflows is essential for their effectiveness in conceptual design.

Various design tools have been developed to support inspiration search and exploration, as well as concept generation. Many of these tools successfully utilize large language models (LLMs) to assist designers in brainstorming, exploring user and engineering requirements, finding design examples, and synthesizing ideas (Ma et al., 2023).

2.1.2 AI Agent

In the book *Artificial Intelligence: A Modern Approach* (2010), the authors define an agent as “anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators” (p. 34).

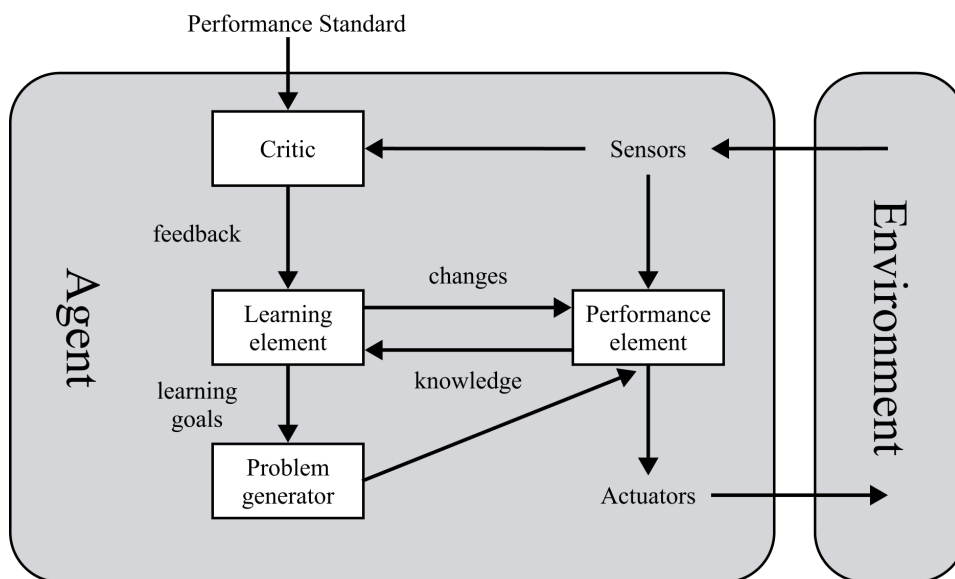


Figure 2.1: A general learning agent divided into four conceptual components. (Russell and Norvig, 2010, p.55). Adapted.

The book continues to explain that most agents are based on similar underlying principles, where the currently preferred method to create modern AI agents is based on the concept of learning agents (Figure 2.1). With the ability to learn from previous interactions, AI agents have the ability to provide personalized experiences and better responses. By creating subtasks out of given instructions by the user, the agents can complete complex tasks and fill in information gaps (IBM, 2024).

2.1.3 NextGen AI

NextGen AI, or next-generation generative AI, represents a significant advancement in AI (Sharma, 2024). The use of advanced learning algorithms that continuously improve and adapt based on current knowledge and interactions is a hallmark of NextGen AI, making it more capable of addressing complex challenges. The next generation of AI is set to revolutionize the way AI can be used, offering benefits that drive efficiency, personalization, and improved customer experiences.

However, there are challenges and uncertainties with adopting NextGen AI. The inherent challenges concern biases, hallucinations (when the AI generates wrong answers), and privacy concerns (Sharma, 2024; Willige, 2024).

2.1.4 Retrieval-Augmented Generation Agent

While Large Language Models (LLMs) like ChatGPT, DeepSeek, and Gemini, excel in producing high-quality, human-like texts, they are trained on large datasets and perform better on more general tasks. Retrieval-Augmented Generation (RAG) AI agents combine LLMs' capabilities to generate content with retrieval mechanisms; "These systems retrieve real-time information from sources such as knowledge bases, application programming interfaces (APIs), or the web, effectively bridging the gap between static training data and the demands of dynamic applications" (A. Singh et al., 2025, p.2).

Given its application within the domain of automotive design, where domain-specific knowledge is critical, a RAG agent is particularly appropriate as the engine of this AI agent.

2.2 Intended Future

Intended Future is a pioneering start-up company founded in 2021. They specialize in the development of services, methods, and algorithms for evaluating the perceived quality of products. Currently, Intended Future is aiming to develop AI agents in several different areas of the automotive industry. Their innovative approach is based on analyzing customer preferences using data inputs from all five human senses, creating large-scale datasets, and advanced machine-learning techniques. Innovations within the field of AI from start-ups are encouraged by the EU AI Act (European Parliament, 2025).

With roots in over a decade of research from the world’s leading automotive engineering institute, Chalmers University of Technology, Intended Future is aiming to deliver reproducible and reliable results in the domains of car design analytics and forecasting acceptance for novel designs. They deliver a standardized, scalable, and scientific methodology known as the Perceived Quality Framework (PQF), and it has since become a benchmark in the automotive industry (Intended Future, 2023; LinkedIn, 2025)

Unlike traditional approaches, which focus on engineering and cost, it places customer perception at the center of the analysis, ensuring design and engineering efforts focus on what matters most to the end user (Intended Future, 2023).

2.3 Perceived Quality

Perceived Quality (PQ) is about how customers feel about a product. It is not just how products perform, but how they look, sound, feel, and even smell (Stylidis et al., 2020).

According to Stylidis et al. (2020) from an engineering viewpoint, Perceived Quality (PQ) is an inevitable part of new product development, extending beyond customer perceptions. Stylidis defines PQ through the Perceived Quality Framework (PQF), in which human experience intersects with product meaning, form, sensorial properties, and their execution (Figure 2.2). This interplay serves to ensure that perceived quality is not merely a reflection of customer preferences, but rather a consequence of the product’s design and context (Stylidis et al., 2020).

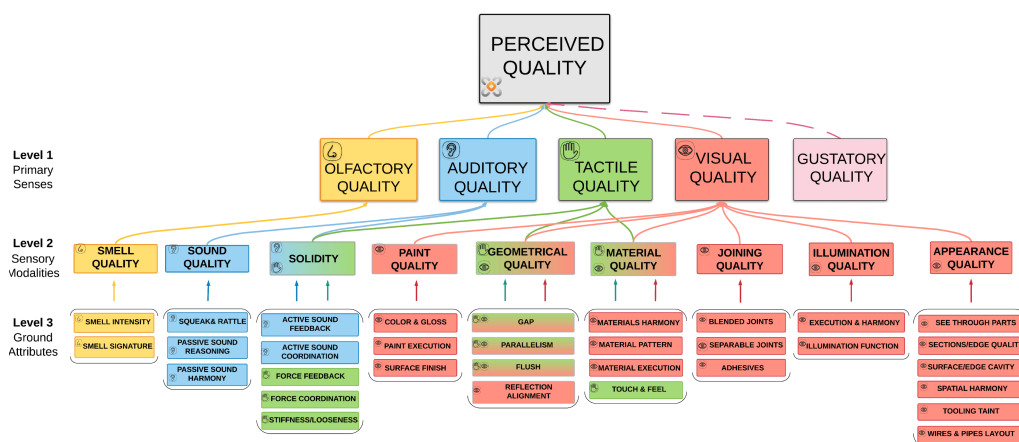


Figure 2.2: Attributes levels of the Perceived Quality Framework (PQF). (Stylidis et al., 2020, p. 49). Reprinted with permission.

Perceived Quality defines successful design and is one of the most critical aspects of product development. Stylidis et al. (2020) explain that Perceived Quality is a complex and multifaceted adaptive system where a human is the main agent. Perceived Quality has historically been depicted as not quantifiable or subjective, as the opposite of “real” or “objective” quality, with an importance on customer perception. However, recently there have been advancements in the way of thinking about quality, connecting objective and subjective quality domains (Stylidis et al., 2020).

They explain that high Perceived Quality signifies the attractiveness of the product to the customer. However, attractiveness is relative and exists only in contrast to what previously did not attract attention (Stylidis et al., 2020).

Engineers are constantly challenged with finding a balance between how much resources should be spent on a feature versus how important that feature is, in terms of performance and consumer satisfaction. Perceived Quality can according to Stylidis et al. (2020) aid engineers in finding this equilibrium.

2.3.1 Color, Materials, Finish

Color, Materials, and Finish (CMF) design is the process of specifying and designing colors, materials, and finishes to support the emotional and functional attributes of products (Becerra, 2016). The selection of color, materials, and finishes is regarded as a foundational part of the design process and consists of identifying the most appropriate materials to ensure the best product performance, balancing visual beauty with functional performance (Becerra, 2016). This interplay between visual and tactile design characteristics (Level 1: Primary Senses PQF (Figure 2.2)) influences a wide range of factors, including product perception, safety (Privitera, 2019), and socio-cultural trends and design languages (Becerra, 2016).

Given this significance, an important aspect of Perceived Quality (PQ) is Color, Materials, and Finish (CMF), which falls under the Material Quality criterion within the Perceived Quality Framework (PQF) (Figure 2.2). As part of a broader research initiative funded by Vinnova, the potential integration of CMF, circularity, and artificial intelligence (AI) in vehicle design will be explored (Vinnova, 2024). Given that CMF is a critical component of PQ, and that certain aspects of these research projects will intersect, insights from CMF designers will be collected to provide valuable contributions to this project.

2.3.2 Customer Acceptance Index

The Customer Acceptance Index (CAI) is a strategic tool developed by Intended Future to align automakers' design choices with customer preferences (Stylidis, 2023). CAI is a long-term data collection tool with one primary goal: to gather clean, standardized data in a consistent format (Stylidis et al., 2024). Ensuring the reliability and effectiveness of AI agents in the automotive industry is dependent on the quality and consistency of the data used for their training (Munappy et al., 2022), therefore, CAI will be integrated into the AI agent to assess and predict customer preferences more accurately.

Traditionally, customer acceptance often relies on marketing departments' data from surveys, focus groups, or panels (Stylidis, 2023). The author highlights that, while these are often well executed, the quality and relevance of the results can be questionable and often prove to be statistically insignificant and add bias rather than clarity.

To overcome these limitations, CAI combines several unorthodox methods to provide both qualitative and quantitative data (Stylidis, 2023). Traditional methods such as Rensis Likert's Likert Scale, where participants get to rate objects on a scale of 1 to 5, lack to reflect real-life decision-making, where all options are not available at the same time, or when there are only less desirable options to choose from (Stylidis, 2023).

To cope with this issue, CAI utilizes the Best-Worst Scaling (BWS) methodology, a statistical method created by Jordan Louviere (Stylidis, 2023; Stylidis et al., 2024). Instead of rating options, BWS presents participants with a selection of options where they select their favorite and least favorite options. This mimics real-life shopping experiences generating more in-depth, nuanced data, leading to a detailed understanding of consumer preferences (Stylidis, 2023).

In addition, Stylidis (2023) states that Likert Scale ratings can be problematic because participants may interpret the same rating differently. The author explains that BWS focuses on relative preferences, encouraging participants to make clear choices and distinguish between good and great options, providing a better understanding of consumer hierarchies.

The agent will facilitate interaction with CAI-based insights, allowing designers and engineers to make informed decisions based on real-life consumer evaluations.

3

Theory

The following sections present the theoretical foundation of this study. First, it reviews existing research on the design of AI agents (section 3.1) and common Barriers to AI Adoption (section 3.2). It then introduces relevant Theories for Designing Interfaces (section 3.3) and User-centered Design (section 3.4). Lastly, it presents the design methodology applied in this study (section 3.5).

3.1 Design Principles for AI Agents

Throughout the years, several guidelines for human-computer interaction (HCI) have been proposed. However, there is a gap in research on guidelines for generative AI agents (Weisz et al., 2024). These agents create a new type of interaction between users and computers and therefore require specific recommendations.

Weisz et al. (2024) suggest six *Design Principles for Generative AI Applications*. First, *Design Responsibly* requires adopting a human-centered approach by understanding and prioritizing user needs and addressing and mitigating potential harms. This includes balancing conflicting stakeholder values, managing emergent behaviors, and implementing mechanisms to test and monitor for user harms such as bias or misinformation.

Second, *Design for Generative Variability* includes assisting users manage the generative model’s ability to produce diverse outputs. This can be achieved by generating multiple outputs to increase the likelihood of meeting user needs, visualizing the user’s journey, enabling curation and annotation of outputs, and highlighting differences between outputs.

Third, *Design for Mental Models* emphasizes clear communication of the AI system’s behavior, taking into account the user’s background and goals. It is essential to educate users about generative variability, provide examples and explanations to

teach effective use, build on existing mental models, and tailor interactions based on user preferences.

Fourth, *Design for Co-Creation* focuses on enabling collaborative interactions between the user and the AI system. Users should be assisted in crafting effective prompts, provided with control over generic and use-case-specific input parameters, and support joint editing of generated outputs.

Fifth, *Design for Appropriate Trust and Reliance* involves helping users determine when to trust AI outputs by being transparent about the system's capabilities and limitations. It should provide rationales for outputs, introduce friction to encourage critical evaluation, and clearly define the AI's role within the user's workflow. This also complies with the European Parliament (2025) AI Act regarding transparency requirements.

Finally, *Design for Imperfection* acknowledges that AI-generated outputs may not always meet user expectations. To address this, systems should make uncertainties visible, evaluate outputs using domain-specific metrics, offer ways to improve outputs, and provide feedback mechanisms to enhance the AI system.

3.2 Barriers to AI Adoption

Understanding and addressing barriers to AI adoption is essential to the development and integration of AI agents in the automotive industry. These barriers influence how AI is perceived, used, and trusted, which impacts its effectiveness in assisting automotive designers. By recognizing and addressing these challenges, the features and interface of the AI agents can be designed to overcome the identified barriers and develop a tool that meets the needs and expectations of automotive designers.

3.2.1 AI Adoption in the Automotive Industry

There are specific barriers to the adoption of AI technology in the automotive industry. In a recent case study by Reddy et al. (2024), the authors investigated the adoption of artificial intelligence in the context of automotive research and development (R&D). Their study identified twelve key inhibitors of AI adoption. The top four inhibitors, namely: (1) a lack of sustained commitment from leadership teams; (2) insufficient collaboration and coordination within and across the business functions; (3) limited experimentation scope; (4) a lack of AI acumen, collectively accounted for 75% of the weightage and were primarily related to organizational

culture (trust, commitment, awareness of AI fit, and alignment). Therefore, it is imperative to translate the results of the AI into a language that the leadership team comprehends.

Due to their inherent complexity, AI-generated results can be subject to failure, which can lead to discouragement and regression to more conservative and low return on investment (ROI) approaches (Reddy et al., 2024). In such cases, it is imperative for the leadership team to adopt a failure-tolerant culture, as AI has been shown to deliver above-average value in high-benefit use cases (Reddy et al., 2024).

3.2.2 Trust in AI

Trust in AI agents is critical to enable effective interaction and collaboration between humans and automated systems (Hancock et al., 2011). As mentioned in the article, the presence and development of trust significantly influence users' receptiveness and how they perceive robotic entities and, by extension, AI agents. Ultimately, high trust in AI not only strengthens user engagement but also results in easier integration of these technologies into daily life and professional contexts, which will be important when creating an AI for the automotive industry.

According to von Eschenbach (2021), trust in AI requires both that we have a reason to believe that the AI is reliable and is acting on our behalf. He states that in order for us to judge AI as trustworthy, transparency into how it operates and reaches its outcomes is necessary. Transparency is also regulated and required in the EU AI Act (European Parliament, 2025).

In a study by Bedué and Fritzsche (2021) investigating trust requirements to successfully adopt AI, they found several subcategories for the three main trust dimensions in traditional technologies (ability, integrity, and benevolence). The subcategories that increase overall trust in AI were: (1) Access to Knowledge; (2) Transparency; (3) Explainability; (4) Certification; (5) Standards and Guidelines. Thereby they found fundamental differences in building trust in AI compared to more traditional technologies.

As von Eschenbach (2021) already mentioned, Bedué and Fritzsche (2021) highlights that *transparency* plays a much more significant role in AI than it generally does in most technologies. *Explainability* in AI refers to the ability to make an AI system's decisions understandable through verbal explanations, visualizations, or simplified models and is crucial for trust as it helps users assess reliability and liability concerns (Bedué and Fritzsche, 2021). Bedué and Fritzsche (2021) continues to highlight

access to knowledge as an important requirement for trust in AI, and that this sometimes is lacking in customers and even regulatory institutions. The authors found in their interviews that *standards and guidelines* are the most important prerequisites for increasing trust in AI as they may increase security and privacy perceptions. *Certifications* have also been shown to enhance security and privacy perceptions and serve as indicators of a company's competence and capability, contributing to its integrity (Bedué and Fritzsche, 2021).

3.3 Theories for Designing Interfaces

Interface design directly influences trustworthiness, which in turn affects users' intention to use a tool (Zieglmeier and Lehene, 2021). Grounding design processes in established theories of usability, user experience (UX), and accessibility provides a good starting point for creating user-centered interfaces.

3.3.1 Usability

When designing an interface, Usability is central to ensuring user satisfaction and efficiency. Usability is a term that is related to how user-friendly a system is to interact with and is seen by web software development managers and practitioners as one of the most important quality criteria for web application success, along with reliability and security (Offutt, 2002). Good usability makes products and interfaces easy to use, allowing users to fully benefit from their features without frustration. Poor usability consequences can range from minor inconveniences to serious safety risks, such as being distracted from using a car's features when driving (Jordan, 2020). Jordan proposes ten principles of usable design;

- *Consistency*: Designing a product so that similar tasks are done in similar ways.
- *Compatibility*: Designing a product so that its method of operation is compatible with users' expectations based on their knowledge of other types of products and the 'outside world'.
- *Consideration of user resources*: Designing a product so that its method of operation takes into account the demands placed on the users' resources during interaction.
- *Feedback*: Designing a product so that actions taken by the user are acknowledged and a meaningful indication is given about the results of these actions.

- *Error prevention and recovery*: Designing a product so that the likelihood of user error is minimized and so that if errors do occur, they can be recovered from quickly and easily.
- *User Control*: Designing a product so that the extent to which the user has control over the actions taken by the product and the state that the product is in is maximized.
- *Visual Clarity*: Designing a product so that information displayed can be read quickly and easily without causing confusion.
- *Prioritization of functionality and information*: Designing a product so that the most important functionality and information is easily accessible to the user.
- *Appropriate transfer of technology*: Making appropriate use of technology developed in other contexts to enhance the usability of a product.
- *Explicitness*: Designing a product so that cues are given as to its functionality and method of operation.

Jordan's principles are well established within the field; however, other specialists have proposed guidelines for good usability. Noteworthy among them is Nielsen, who proposed ten Usability Heuristics for User Interface Design (Nielsen, 1994);

- *Visibility of System Status*: Keep users informed about what is happening through appropriate feedback within a reasonable amount of time.
- *Match Between System and the Real World*: Use language and concepts familiar to the user, making information appear in a logical order.
- *User Control and Freedom*: Provide users with options to exit, undo or redo actions, allowing them to easily correct mistakes and navigate freely.
- *Consistency and Standards*: Ensure that design elements and terminology are consistent throughout the interface, adhering user expectations.
- *Error Prevention*: Design systems to prevent errors by guiding users and providing clear options, reducing the likelihood of mistakes.
- *Recognition Rather Than Recall*: Minimize the user's memory load by making interface elements visible, so they do not have to remember information from one part of the interaction to another.

- *Flexibility and Efficiency of Use:* Cater to both new and experienced users by providing shortcuts to speed up interactions and allow users to tailor frequently used actions.
- *Aesthetic and Minimalist Design:* Keep designs uncluttered by including only relevant information and elements, avoiding unnecessary complexity.
- *Help Users Recognize, Diagnose, and Recover from Errors:* Use clear and concise error messages that help users understand the problem and provide solutions to fix it.
- *Help and Documentation:* If necessary, offer help resources to help users understand how to complete tasks and resolve issues.

According to a study made by Fernandez et al. (2011), methods for evaluating web interfaces evaluate different usability aspects depending on what definition of usability is used. The author determines that there is not one single method that is recommended to use in all circumstances and for all types of interfaces and purposes, and that a combination of methods could provide a better result.

3.3.2 User Experience

To successfully design an interface, the experience it offers must be considered not only from a usability perspective but also from a user experience (UX) perspective.

User experience encompasses the emotional response of the user and the overall interaction with a system, making it a more subjective concept compared to usability (Sharp et al., 2019). According to Sharp et al. (2019), while usability focuses on efficiency and ease of use, UX is influenced by factors such as time, place, and the user's emotional state. Despite their distinctions, UX and usability are deeply interconnected. Usability significantly shapes UX, while aspects like visual appeal and responsiveness contribute to a system's usability (Sharp et al., 2019).

As Sharp et al. (2019) states, UX cannot be designed directly, but it can be designed for. Users will inevitably have unique experiences, yet designers can establish and optimize UX goals to align with intended outcomes. By considering factors such as cognitive load, designers can enhance the likelihood of a satisfying experience (Sharp et al., 2019). The authors state that positive UX outcomes include engagement, satisfaction, and helpfulness, while negative experiences, such as frustration, boredom, or discomfort, should be minimized to ensure an effective and user-friendly system.

According to Marc Hassenzahl (2004), user experience includes all aspects of interaction with a product and is subjective. Consequently, actual experiences with products may considerably differ from those intended by the designer because of personal standards and situations, which may also change over time (Hassenzahl, 2004). He explains that products have a character that suggests pragmatic and hedonic attributes, and that good design should address both needs. Good design is therefore not only a design that works but is a design that stimulates, identifies, and evokes positive emotions in users, ensuring an appealing, pleasurable, and satisfactory experience (Hassenzahl, 2004).

This is further emphasized by Pieter Desmet (2003), who defines user experience as deeply intertwined with the emotional and subjective well-being of human-product interaction. He underscores the importance of designing products that not only fulfill practical needs but also have the potential to improve the emotional and psychological well-being of users (Desmet, 2003; Fokkinga et al., 2020).

To fulfill the practical, emotional, and psychological needs of the users, Desmet (2003) presents the Multilayered Model of Product Emotions, which emphasizes the importance of understanding the cognitive processes that lead to emotional responses in users. Rather than focusing solely on the behavioral consequences of an experience, this model highlights the importance of examining users' underlying concerns and how a product stimulates their emotions. By gaining insight into these cognitive and emotional mechanisms, designers can create experiences that are more aligned with their intended goals and ensure that products elicit meaningful and desirable emotional responses.

In conclusion, the notion of UX is subjective and dynamic, influenced by users' emotions, past experiences, and context. Both Hassenzahl (2004) and Desmet (2003) underscore the significance of aligning UX with the designer's intended goals by comprehending cognitive and emotional processes, ensuring that products evoke meaningful and engaging experiences.

3.3.3 Accessibility

Accessibility is a term with various definitions which can be considered from different perspectives. ISO 9241-171 (2008) defines accessibility as “the usability of a product, service, environment, or facility by people with the widest range of capabilities”, a definition covering the use of multiple types of systems. While this serves as a good foundation for inclusive design, there are guidelines that specifically target the accessibility of web systems and that will guide this project in a better direction.

By June 2025, the European Accessibility Act (EAA) will come into effect (AccessibleEU, 2025). If a company does business in the European Union (EU) within the Information and Communications Technology (ICT) sector and fails to comply with the new law, it could face legal repercussions such as fines (AccessibleEU, 2025; DIGG, 2024). The EAA is based on the European standard for Accessibility and Inclusive Design, EN 301 549, and covers a wide range of ICT products and services, including accessibility of websites, interfaces, and more (DIGG, 2024). The European Standard EN 301 549 is derived from the international standard Web Content Accessibility Guidelines (WCAG) 2.1 and can be regarded as complementary, serving to ensure that ICT products within the EU are accessible and inclusive of people with disabilities and other specific needs (DIGG, 2024).

W3C (2024) presents the following four principles of accessibility in the WCAG 2.1 guidelines: (1) *Perceivable*, users should be able to perceive the information and interface components that are presented through different senses; (2) *Operable*, users should be able to operate and navigate through all parts of the interface; (3) *Understandable*, the information presented and how to operate the interface should be understandable to users; (4) *Robust*, the content should be reliable enough to be interpreted by a variety of user agents, including different assistive technologies.

The principles have a total of 13 guidelines, where each guideline is rated on the success criteria A, AA, and AAA and determines conformity to WCAG (W3C, 2024). To meet the accessibility directive 2025, levels A and AA must be met (DIGG, 2024).

Intended Future’s revenue and number of employees fall below the thresholds defined by the EAA. Therefore, compliance with these standards is not required for the interface created in this project. However, it will remain an important factor to consider during the design process. Aizpurua et al. (2016) conclude in their study that websites’ accessibility has a significant correlation with user experience, elaborating that it affects how a website is perceived in terms of being “inclusive, presentable, brings me closer to people, professional, integrating, valuable, and classy” (p. 22).

3.4 User-Centered Design

User-centered Design (UCD) is an approach to design and product development that involves the user in the process. It is driven by designers' understanding and empathy for the people who will use the product or service (Fokkinga et al., 2020). Fokkinga et al. (2020) states that by considering users' goals, feelings, abilities, and practices, designers can create products that ultimately strive to make a positive impact on people's lives. According to ISO 9241-210 (2019) the following principles should be followed in a user-centered design process: (1) The design is based upon an explicit understanding of users, tasks and environments ; (2) Users are involved throughout design and development; (3) The design is driven and refined by user-centered evaluation; (4) The process is iterative; (5) The design addresses the whole user experience; (6) The design team includes multidisciplinary skills and perspectives.

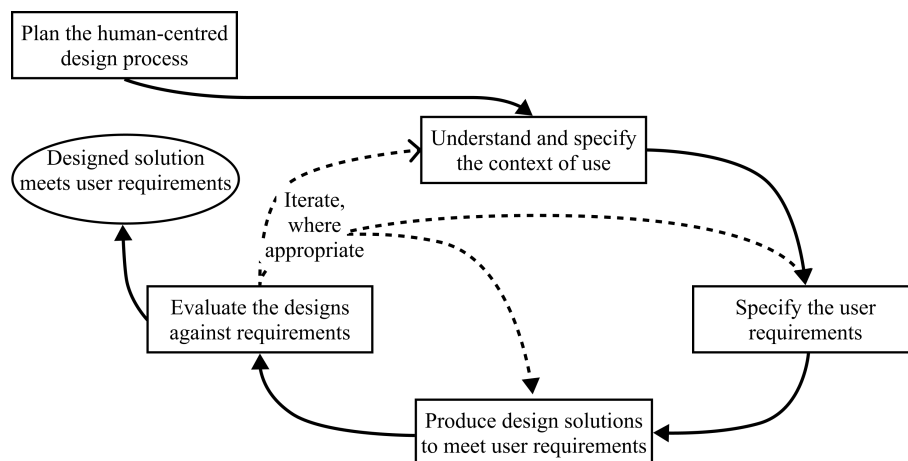


Figure 3.1: The four phases of the user-centered design process for interactive systems. (ISO 9241-210, 2019). Adapted.

ISO 9241-210 (2019) also proposes a general process for user-centered design (Figure 3.1). The first part consists of understanding and specifying the context-of-use, which includes identifying the users and stakeholders, their characteristics, goals, and the environment of the system. Next, user needs and requirements should be identified and derived. Based on these user requirements, design solutions are then produced. The fourth phase involves evaluating the design solutions with the user. This process is iterative and should go through multiple cycles before reaching the final solution.

By following and applying UCD in this thesis, it will ensure that the interface considers both usability and user experience.

3.5 Design Thinking

Design Thinking is an iterative design process that serves as the foundational methodology of this thesis. The purpose of design thinking is to understand and develop empathy for the user, question assumptions, and reframe problems to uncover solutions that may not initially be obvious (Friis Dam and Yu Siang, 2021). Design Thinking has proven effective in tackling unknown problems, such as the development of a novel technology like the PQ AI agent in this thesis, by generating many ideas in brainstorming sessions, and adopting hands-on approaches like prototyping and testing (Friis Dam and Yu Siang, 2021). The non-linear, iterative nature of design thinking allows for continuous user feedback at various stages of the process, making it efficient and cost-effective.

Design Thinking was first described by Nobel Prize Laureate Herbert Simon in 1969, although the focus of this thesis is on the model proposed by the Hasso-Plattner Institute of Design at Stanford (Friis Dam and Yu Siang, 2021). The model proposes five phases of Design Thinking: (1) *Empathize* - with the users; (2) *Define* - the user's needs, their problem and the insights; (3) *Ideate* - by questioning assumptions and generating innovative ideas and solutions; (4) *Prototype* - create the solutions, and (5) *Test* - try the solutions. The phases are shown in Figure 3.2; however, the steps are not always sequential. The model is adaptive, and phases are often executed out of order, in parallel, or repeatedly.

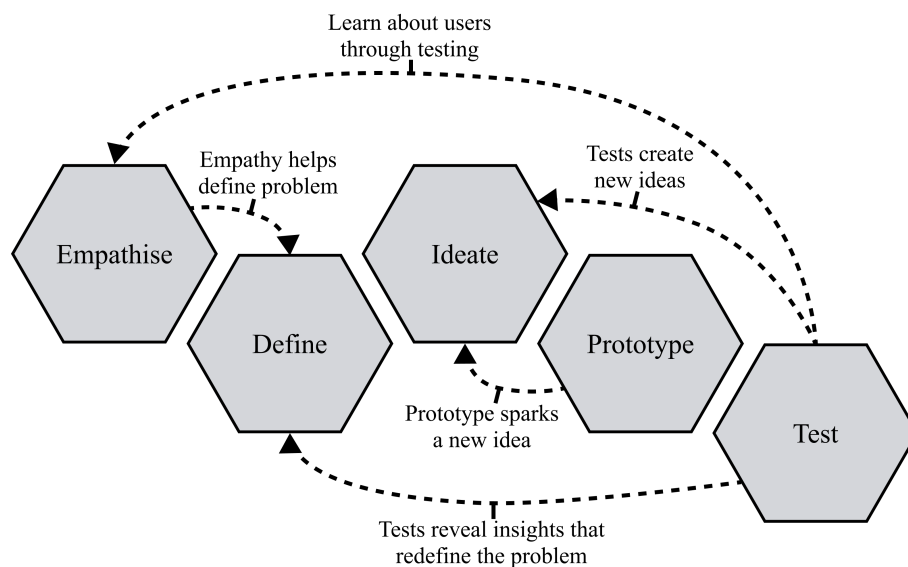


Figure 3.2: Illustration of the Design Thinking model. (Friis Dam and Yu Siang, 2021). CC BY-NC SA 3.0

4

Methods and Processes

This chapter presents the specific methods and procedures used throughout the study and how they were carried out. The process begins with a Literature Review (section 4.1) and continues with qualitative Data Collection (section 4.2), analysis (section 4.3), and User Journeys (section 4.4), which form the foundation for generating insights. These insights then served as the basis for developing actionable design guidelines. Concurrently, visual representations of the insights were formulated through Ideation (section 4.5) and subsequent Wireframing (section 4.6) and Prototyping (section 4.7). Finally, Ethical Considerations regarding the method are discussed (section 4.8).

4.1 Literature Review

The project was initiated by reviewing existing literature on relevant topics. The literature review was conducted to gain knowledge about topics such as Perceived Quality, Color, Materials, and Finish, and Artificial Intelligence, and conclude them into what is currently known in the industry. As the review progressed, new topics of interest emerged and shaped the continuation of the project.

The literature review was performed by scanning and selecting relevant literature from databases such as Google Scholar and the Chalmers Library. These databases were chosen because of their extensive collection of academic and industry-relevant resources, ensuring credibility in our research. The sources of value were carefully collected and read in the reference management tool Zotero (n.d.), where we could systematically organize and highlight relevant information, to keep track of and synthesize relevant findings.

Articles, journals, and books were primarily used as credible sources of information. However, given the rapid development of AI, peer-reviewed information was scarce.

Therefore, other sources of information sometimes had to be used, such as blog posts by industry professionals and websites, and, whenever possible, cross-reference them with credible sources for validation.

4.2 Data Collection

Due to the inherent contextual conditions of the field of automotive design, the research strategy of a case study has been applied (Yin, 2018). The present study employed a qualitative research design, utilizing interviews as the method for data collection. Qualitative research methods are generally used to understand the motives behind people's behaviors and actions and result in a more in-depth perspective on research findings (Rosenthal, 2016). This study employed semi-structured interviews, which allow the interviews to have a clear focus but gives the interviewee the opportunity to delve deeper and explore topics not initially encompassed within the predetermined framework (Adeoye-Olatunde and Olenik, 2021).

4.2.1 Study Participants

The study sample consisted of 12 interviewees in total. The panel included eight professionals with extensive experience in the automotive industry and strong design backgrounds. Their expertise spanned areas such as engineering, Design Quality (DQ), and Colors, Materials, Finish (CMF) (see Figure 4.1).

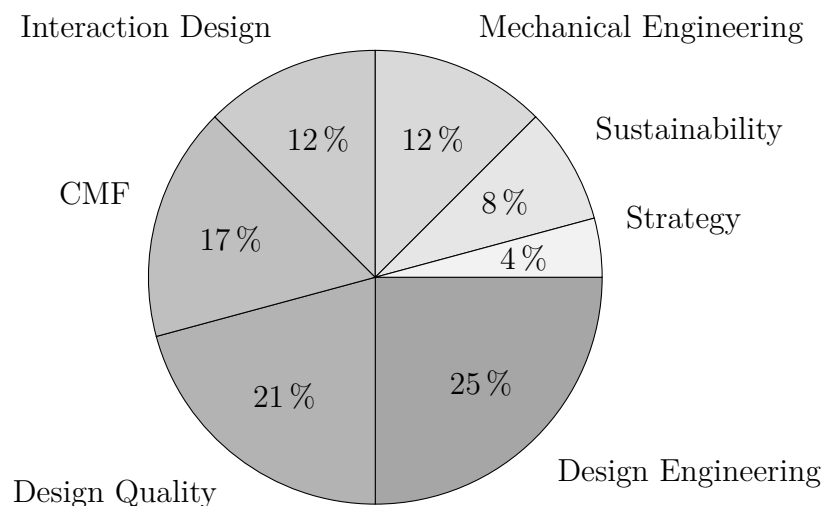


Figure 4.1: Participants' backgrounds and areas of expertise

The participants' automotive experience ranged from a minimum of five years to a maximum of 40 years, with an average of 23 years of experience. The professionals

represented four companies that are active in the automotive industry and were located in Sweden and France. To expand the insights of professionals and represent the new emerging automotive designers, four Master of Science students from design programs were interviewed. All students have engaged in academic work within the automotive industry. The list of interview participants can be found in Table 4.1.

Table 4.1: Interview participants with demographic details, professional roles, and experience in the automotive industry.

ID	Gender	Company	Country	Current Role	Experience
P1	F	OEM 1	Sweden	Senior CMF Designer	18 years
P2	M	OEM 2	Sweden	Chief Designer	5 years
P3	M	Tier 1 Supplier	France	Innovation Manager	26 years
P4	F	OEM 3	Sweden	CMF Studio Engineer	9 years
P5	F	OEM 1	Sweden	Design Quality Specialist	29 years
P6	F	OEM 1	Sweden	Design Quality Specialist	40 years
P7	F	OEM 1	Sweden	Design Quality Specialist	31 years
P8	F	Tier 1 Supplier	France	Sustainability Leader	27 years
P9	F	University 1	Sweden	Master's Student, Industrial Design Engineering	N/A
P10	F	University 1	Sweden	Master's Student, Industrial Design Engineering	N/A
P11	M	University 1	Sweden	Master's Student, Interaction Design & Technologies	N/A
P12	M	University 1	Sweden	Master's Student, Interaction Design & Technologies	N/A

The rationale behind the sampling of the interviewees was to understand the potential users of an AI design assistant software, which in this case was primarily targeted at designers working with PQ evaluations or CMF design. This approach enabled the development of a comprehensive understanding of how the industry defines and assesses design quality attributes, as well as its approach to AI.

4.2.2 Interviews

The semi-structured interview guide was developed in collaboration with industry professionals in the automotive and product design sectors through a series of workshops, ensuring the relevance and validity of the questions posed. The aim of the questions was to gain insight into the barriers and opportunities of AI within the automotive industry, the existing design quality assessment workflow, and the functionalities users would desire in an AI design assistant.

A pilot study was conducted with Industrial Design Engineering master's students to ensure the questions were appropriate for individuals with limited professional experience and to identify any potential misalignment between the questions' complexity and the interviewees' experience level.

The semi-structured interviews were conducted in places of convenience for the interviewees. The interviews were adapted to suit the roles of the interviewees, depending on whether their background was in the area of General Design/PQ or CMF, but followed the same structure, see Appendix A. For example, the interviews began with questions about the interviewee's background and experience:

- Could you briefly describe your background and role as a designer?
- How long have you been working with automotive projects, and how has your role evolved?

This was followed by questions about the design process currently used by the professionals, commonly encountered challenges in this process, and questions regarding the evaluation of designs. For example:

- How and where in the design and development process do you measure how good a design is?
- Who/what is the arbiter of a good design outcome?

Subsequently, questions regarding the automotive industry’s current use of AI, barriers, opportunities, and needs of a potential AI design assistant. Questions included:

- Would you trust AI-generated design recommendations? If not, what would be required to build that trust?
- If a Design Assistant were available, what tasks would you want/need/expect it to assist with?

A complete list of questions can be found in Appendix A.

4.3 Qualitative Data Analysis

In this thesis, the Grounded Theory methodology was used for the Qualitative Data Analysis (QDA) (Corbin and Strauss, 1990), because of its pragmatic focus on participants’ problems, and its systematic analysis process helps uncover themes from data (Chapman et al., 2015). Grounded Theory is mainly an inductive approach in which the hypothesis is generated from the data, contrary to deductive, where the hypotheses are tested via data (Chapman et al., 2015). The authors describe it as an iterative process in which data collection and analysis occur simultaneously. Thus, early findings can inform further data collection, which is not purely inductive. This data adds to the existing understanding until there are no new insights and saturation is reached.

Thematic Analysis, within the context of Grounded Theory, provides a structured approach to analyzing qualitative interview data in the automotive design setting. The Thematic Analysis method can according to Braun and Clarke (2006) be described as the following six phases: (1) Familiarizing yourself with your data; (2) Generating initial codes; (3) Searching for themes; (4) Reviewing themes; (5) Defining and naming themes; (6) Producing the report.

4.3.1 Thematic Analysis

The interviews were transcribed with the aid of aTrain, a locally installed AI tool that runs offline, meaning that data does not leave the local machine, ensuring data privacy and General Data Protection Regulation (GDPR) compliance (Haberl et al., 2024). The initial transcripts were subsequently compared with the original audio files and manually corrected.

Inductive coding was performed on the transcripts, a bottom-up approach that derives codes from the data without preconceived notions of what the codes should be, allowing codes to emerge gradually. As part of this process, meaningful excerpts were identified and segmented through a series of workshops, where the two researchers discussed and agreed upon the relevance and boundaries of each excerpt. The excerpts served as unitized segments, the foundational units of analysis, following Krippendorff (2019) framework for Unitizing. In unitizing, units are defined as self-contained meaningful excerpts of text identified within an otherwise continuous flow of information that are then treated as independent from both their original context and from each other (Krippendorff, 2019). The open codes derived from these units were then coded axially, linking related codes and grouping them into themes. The analysis followed a cyclical and iterative pattern in which each round of data collection (specifically interviews) was followed by data analysis, comparison with prior codes, and refinement and addition of codes and themes as the work progressed. This iterative method ensured that both the unitization and thematic structure evolved with increasing depth and consistency across the dataset.

By the end of the data collection phase, a total of 745 quotes were extracted from the eight interviews conducted. These quotes were systematically categorized into nine thematic areas, which emerged gradually throughout the process: (1) *Background and Experience*; (2) *Design Process Workflow*; (3) *Challenges in the Design Process*; (4) *Design Quality and Decision-Making*; (5) *Validation and Evaluation Techniques*; (6) *Adoption and Use of AI Tools in Design*; (7) *Trust, Reliability, and Limitations of AI Tools*; (8) *Desired Features and Collaborative Environments for AI-Driven Tools*; (9) *Industry Readiness and Barriers to AI Adoption in Design*. In total, 67 distinct codes were applied across these themes (see Appendix B for a full list of codes). This extensive dataset provided a solid foundation for concluding insights regarding designers' workflows, the challenges they face, current and potential uses of AI, the readiness of the industry for AI adoption, and the key features they desire in future AI tools. Moreover, it acted as the base for creating design guidelines for user-centered AI agents.

4.4 User Journeys

This section presents personas, journey maps, and user flows developed to model user needs and system interactions. These tools provided a foundation for designing intuitive, goal-oriented experiences based on the user.

4.4.1 Personas

To gain a better understanding of the users, personas were created. Personas are fictional individuals created to represent groups of target users who share similar characteristics (Adlin and Pruitt, 2010), which creates several benefits for designers. According to Miaskiewicz and Kozar (2011), the most significant benefit of personas is that they allow designers to focus on the actual goals of the target customer, which is further built upon by Adlin and Pruitt (2010), who state that personas help to understand users with different viewpoints than oneself and make better decisions. Personas also help designers integrate user needs and goals into the design, bridging the gap between designers and consumers (Miaskiewicz and Kozar, 2011). Another benefit of personas is the ability to make assumptions about users explicit, establishing a common ground for discussions about users (Adlin and Pruitt, 2010).

Two personas were developed to represent distinct types of users on opposite ends of AI familiarity. Initial drafts were generated using ChatGPT, based on a prompt describing the persona structure and detailed project context. These drafts were then manually refined using insights from the interviews, incorporating user needs, and recurring attitudes. This iterative process ensured the personas were grounded.

Persona 1: Lars, Master of Craftsmanship

Lars is a 54-year-old senior CMF designer with a master's degree in industrial design. Married with two adult children, he lives in Sweden and has spent decades refining his expertise in automotive design.

He values craftsmanship, attention to detail, and hands-on design processes, trusting experience over digital automation. Passionate about Scandinavian design and sustainability, he enjoys woodworking and sketching. Pragmatic and detail-oriented, he is cautious about change and prefers tradition over rapid innovation.

At work, Lars relies on physical material samples, in-person discussions, and manual sketching. While he uses Adobe Suite, he avoids AI-driven tools, believing human intuition is irreplaceable. He prefers face-to-face meetings and email over digital collaboration.

Lars maintains high CMF standards, mentors younger designers, and advocates for sustainable materials. However, he feels overwhelmed by digitalization and doubts that AI can replace human judgment. He is concerned that younger designers are losing hands-on experience and struggle to adapt to company policies pushing AI.

For industry insights, he turns to design magazines, workshops, and networking events, preferring real-world learning over digital content.

Persona 2: Julia, a Tech-savvy Designer

Julia is a 31-year-old design quality specialist living in Gothenburg. She is at the beginning of her career, yet she has already been assigned a significant role at the automotive company where she is employed.

Driven by curiosity and efficiency, Julia embraces new tools, especially AI, to streamline her workflow, shortening the time spent on boring tasks that take up time from what she really wants to do. She values speed, clarity, and creativity.

At work, Julia uses different tools in her workflow, mostly digital, trying to find inspiration and creativity with the use of generative AI. She is comfortable switching between Slack, ChatGPT, and MidJourney, preferring quick iteration over long processes. However, she sometimes struggles to convince more traditional colleagues of the trustworthiness of vague AI systems.

She stays informed through LinkedIn, design blogs, and newsletters. Outside of work, Julia enjoys urban living and spends weekends exploring local art exhibits, cafés, and second-hand stores.

4.4.2 User Journey Mapping

User journey mapping was used to create an overview of possible user tasks and touchpoints when interacting with the system. According to Howard (2014), user journey mapping provides stakeholders with a high-level overview and adds a third dimension to the two-dimensional profiles offered by personas and is increasingly becoming a valuable tool for designers.

The user journey mapping (see Figure 4.2 and Figure 4.3) was done using the previously created personas (Section 4.4.1) and identified possible scenarios for interacting with the system and the corresponding goals or expectations. The scenarios were divided into phases, which were further divided into actions, reflecting the users' mindsets and emotions during these phases. From the user journey maps created, possible opportunities were identified and summarized.

User Journey Map: Persona 1

USER INFO

Lars is a 54-year-old senior CMF designer with a master's degree in Industrial Design. He has decades of experience in evaluating design aesthetics, craftsmanship, and material execution through traditional methods. He is skeptical of AI-driven tools and prefers hands-on assessments.

SCENARIO & EXPECTATIONS

Lars is tasked with evaluating the perceived quality of a new vehicle design. The company introduces an AI-powered evaluation tool to assist in assessing design details such as fit and finish, surface quality, and visual harmony. Lars expects the tool to enhance his decision-making without replacing his expertise. He hopes for a system that provides clear, data-driven insights while respecting the subjective nature of perceived quality evaluations.

STAGES	STAGE 1 ▶	STAGE 2 ▶	STAGE 3 ▶	STAGE 4 ▶	STAGE 5 ▶
PHASES	Discovery – Learning about the AI Agent	Onboarding – First Interaction with the Tool	Evaluation – Using AI to Assess Perceived Quality	Validation – Comparing AI Insights with Traditional Assessments	Final Decision – Integrating AI into the Evaluation Process
ACTIONS	Lars is introduced to the AI tool in a team meeting. The tool is presented as a way to streamline perceived quality evaluations by analyzing design consistency, alignment, and material interactions.	Lars logs in and explores the AI tool's interface. He tests some sample evaluations but struggles to see how the AI's analysis connects to his expertise.	Lars uploads vehicle design data into the AI tool. The system generates perceived quality scores based on alignment, material execution, and surface consistency. AI highlights potential problem areas.	Lars physically examines the design prototype and cross-references his observations with the AI's analysis. He discusses discrepancies with colleagues, questioning whether the AI correctly captures subjective elements.	Lars incorporates AI insights into his final report but relies on his expertise for the final judgment. He provides feedback on how the AI could better align with human evaluations.
THOUGHTS	"Perceived quality is subjective. How can AI possibly evaluate something that requires human judgment?"	"This feels overly technical. I need to understand why the AI rates certain aspects the way it does."	"Some of these AI insights are interesting, but perceived quality is more than just numbers. Does it understand the subtle details?"	"AI is catching some details I might have missed, but it still struggles with certain nuanced aspects of perceived quality."	"AI can help highlight inconsistencies, but it should complement human judgment, not replace it."
PAIN POINTS	<ol style="list-style-type: none"> Doubts AI can assess subjective design qualities. Feels AI undermines human expertise. Lacks clarity on AI's role in his workflow. 	<ol style="list-style-type: none"> Finds the interface unintuitive and overly technical. Struggles to understand AI's reasoning behind evaluations. Prefers hands-on methods over digital tools. 	<ol style="list-style-type: none"> AI's insights feel disconnected from real-world assessments. Unsure whether AI captures subtle design details. Distrusts AI recommendations without human validation. 	<ol style="list-style-type: none"> AI flags issues that don't align with his experience. Lacks confidence in AI's ability to assess craftsmanship. Frustrated by discrepancies between AI and human judgment. 	<ol style="list-style-type: none"> AI lacks flexibility to incorporate subjective insights. Feels AI adds steps rather than simplifying workflow. Concerned AI may eventually replace human decision-making.
EMOTIONS	Scepticism and mild resistance	Confusion and reluctance	Curious, but still hesitant	A mix of trust and skepticism	Acceptance, cautious optimism
OPPORTUNITIES	<ol style="list-style-type: none"> Provide real-world examples of AI-assisted design. 	<ol style="list-style-type: none"> Simple, intuitive interface. Clear instructions and onboarding. 	<ol style="list-style-type: none"> The tool should clearly communicate why it rates perceived quality the way it does, offering transparency to experienced designers. 	<ol style="list-style-type: none"> Visual comparison tools for aligning assessments. Enable expert overrides or annotation of AI feedback. 	<ol style="list-style-type: none"> Position AI as a tool for enhancing, not replacing, human judgment in perceived quality evaluations.

Figure 4.2: Persona Lars's user journey across five stages of adopting an AI tool for design assessment.

User Journey Map: Persona 2

USER INFO

Julia is a 31-year-old design quality specialist living in Gothenburg. Early in her career, she embraces AI and digital tools to streamline workflows and enhance creativity. She values speed, efficiency, and exploration.

SCENARIO & EXPECTATIONS

Julia is tasked with evaluating the perceived quality of a new vehicle design. She's introduced to an AI tool designed to assist with surface and material assessments. She expects the AI to boost her workflow speed, spark creativity, and support her decision-making. She hopes for a seamless, responsive tool that integrates into her existing digital habits.

STAGES	STAGE 1 ▶	STAGE 2 ▶	STAGE 3 ▶	STAGE 4 ▶	STAGE 5 ▶
PHASES	Discovery – Learning about the AI Agent	Onboarding – First Interaction with the Tool	Evaluation – Using AI to Assess Perceived Quality	Validation – Comparing AI Insights with Traditional Assessments	Final Decision – Integrating AI into the Evaluation Process
ACTIONS	Julia joins a team session where the AI tool is introduced. She immediately explores documentation and example outputs.	She signs in, tries features, and uploads a few early design files to test the system.	Julia integrates the tool into her daily routine, using it for assessments of design quality.	She compares the tool's feedback with her team's observations and invites feedback from colleagues.	Julia incorporates AI output into her reports and suggests improvements to the tool team.
THOUGHTS	"This could really speed up my workflow if it's well integrated."	"It's intuitive, but I want to see how deep the insights go."	"I can work faster now, but I still double-check the AI's insights."	"I trust it for initial assessments, but it's important others on the team buy in."	"It adds value to my work, especially when paired with human judgment."
PAIN POINTS	<ol style="list-style-type: none"> Needs clear examples of what the AI evaluates. Wonders how well it handles edge cases. 	<ol style="list-style-type: none"> Some features feel generic at first. Lacks contextual explanations for AI feedback. 	<ol style="list-style-type: none"> Notices inconsistencies in more nuanced material quality assessments. Sometimes unsure when to trust the AI. 	<ol style="list-style-type: none"> Resistance from traditional colleagues limits tool adoption. AI can't always explain "why" something is flagged. 	<ol style="list-style-type: none"> AI insights sometimes too general for final presentations. Cannot replace the human senses.
EMOTIONS	Excitement and curiosity	Motivated but slightly critical	Confident with cautious trust	Optimistic but frustrated	Productive and optimistic
OPPORTUNITIES	<ol style="list-style-type: none"> Provide inspirational use cases. Integrate AI examples with real-world outcomes. 	<ol style="list-style-type: none"> Onboarding should explain rationale behind scores. Add contextual tooltips for each evaluation criterion. 	<ol style="list-style-type: none"> Enable users to give feedback on AI decisions to improve relevance. Provide flags when confidence is low. 	<ol style="list-style-type: none"> Create visual comparisons to bridge AI and human feedback. Include peer-sharing features to support adoption. 	<ol style="list-style-type: none"> Enable export of combined AI + human judgment summaries.

Figure 4.3: Persona Julia's user journey across five stages of adopting an AI tool for perceived quality evaluation.

4.4.3 User Flow Diagram

User flow diagram concepts were created based on insights from the interviews and the user journey maps. According to Interaction Design Foundation (2016) user flow diagrams “depict the path a user can take to complete a task while interacting with a product” and are valuable for clarifying navigation sequences, identifying optimal user flows, and potential roadblocks early on. The user flow diagrams provided a solid foundation for creating wireframes (section 4.6) later in the design process.

4.5 Ideation

The ideation phase was dedicated to the generation of a diverse set of innovative design concepts for the user interface of the Perceived Quality AI agent. The ideation phase was built upon the created User Journeys Maps (subsection 4.4.2), User Flow Diagrams (subsection 4.4.3), and conclusions of qualitative data analysis. It aimed to create visual representations of the conclusions drawn in the previous stages. As stated by Daly et al. (2016), “Success in design is grounded in the concepts generated, developed, and executed throughout a design process” (p. 1). The initial objective of concept generation was to explore the theoretical design solution space in both breadth and depth. The recommended practice involved generating a multitude of concepts, ensuring substantial diversity, and refraining from premature judgments about their value (Daly et al., 2016).

To aid in concept generation, a set of structured methods was applied to balance exploration and focus. We applied the methods of Brainstorming (section 4.5.1), Crazy Eights (section 4.5.2), and Brainwriting (section 4.5.3).

4.5.1 Brainstorming

Brainstorming is a well-established method that allows participants to freely generate as many solution ideas as possible around a predefined problem (Österlin, 2010). This method encouraged an open exchange of ideas, which allowed us to build on each other’s suggestions and explore the design solution space more extensively (see Figure 4.4 for some of the ideas generated during brainstorming sessions). Through associations between ideas, even unconventional concepts had the potential to be refined into perfectly viable solutions.

The sessions prioritized quantity over quality, ensuring a wide range of concepts before evaluation. To maintain a creative and open environment, no criticism of either

positive or negative nature was allowed during the process. This approach fostered a more inclusive and unrestricted ideation phase, which laid a strong foundation for further concept development.

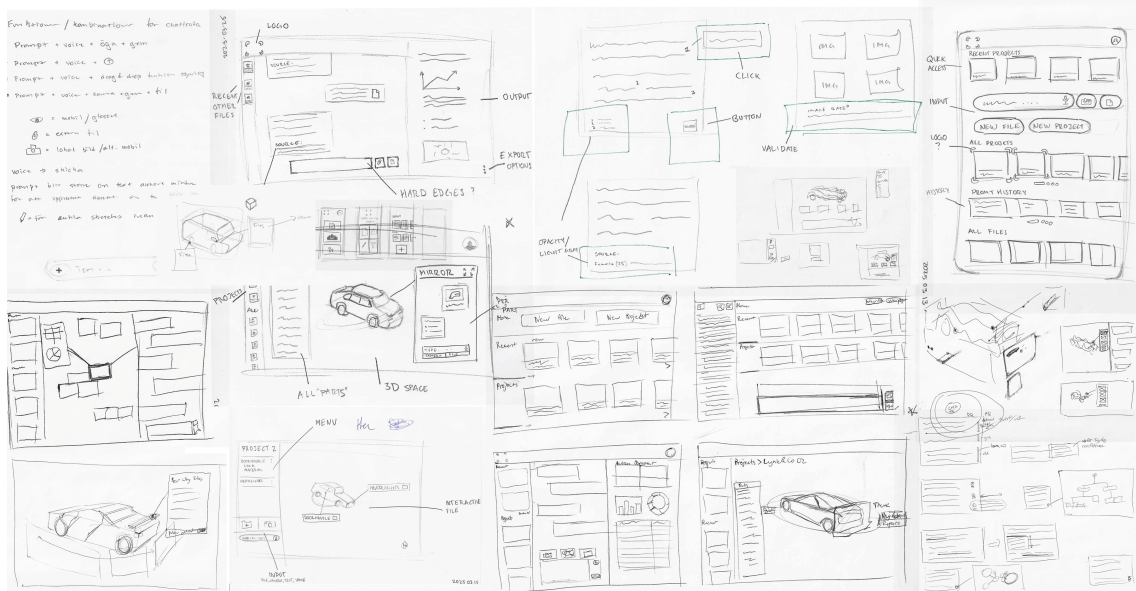


Figure 4.4: Design ideas generated from brainstorming sessions.

Brainstorming was a recurring method that was returned to throughout the project due to its open and allowing nature, making it a valuable practice during the different phases of the project. Whenever a new idea struck, it was written down or sketched out and categorized.

4.5.2 Crazy Eights

To rapidly generate ideas, we used the Crazy Eights (Crazy 8's) method. The objective of this exercise was to sketch and develop eight unique and innovative ideas in eight minutes (Knapp et al., 2016). The strict time limit provided a challenge to think creatively and push beyond conventional solutions. Being forced to work quickly prevented overthinking and encouraged out-of-the-box solutions.

The exercise was prepared by folding a piece of A4 paper into a grid of eight equally sized rectangles. An eight-minute timer was then set, with a signal every minute to help keep track of time and maintain pace throughout the exercise. By the end of each session, a total of 16 sketches of potential interface concepts for the Perceived Quality AI agent had been created, as seen in Figure 4.5.

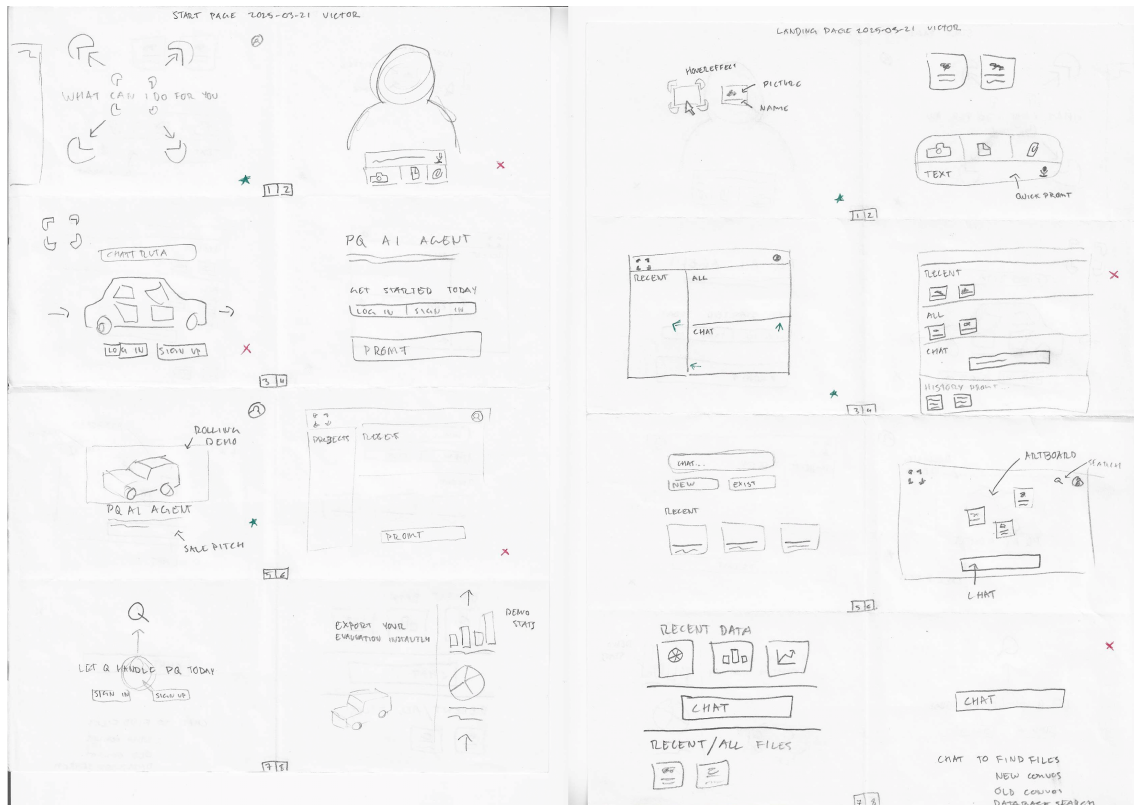


Figure 4.5: The outcomes of two different Crazy Eights sessions.

After the session, ideas were shared and briefly discussed. Rather than selecting ideas to move forward with, sketches that were either not feasible or unlikely to provide value to the intended user (Design Sprints, n.d.) were eliminated. This process allowed for the most promising solutions to be narrowed down while still preserving a broad range of possibilities for further refinement.

4.5.3 Brainwriting

The Brainwriting exercise was conducted to further refine concepts from the Crazy Eights (Section 4.5.2) exercise. Unlike Brainstorming (Section 4.5.1), where ideas were built upon collaboratively, Brainwriting involved documenting ideas separately on paper to avoid rectification, encourage diverse perspectives, and prevent idea fixation (Österlin, 2010).

The Brainwriting sessions were structured as a timed exercise, in which ideas were written down in the correct order of their occurrence. Once all ideas had been documented, they were presented to identify similarities and differences, ultimately serving as inspiration. Following this discussion, further development was carried out on each other's ideas to unlock the full potential of the concepts.

By the end of the session, a wide range of ideas and concepts of varying levels of fidelity had been generated to move forward with. Some of the most promising ideas and concepts were transported into the digital realm that later became the starting point for the Wireframing phase (section 4.6).

4.5.4 Six Thinking Hats

The Six Thinking Hats method was developed by Edward de Bono and is a structured method designed to facilitate parallel thinking and encourage diverse perspectives (De Bono, 1988; Wikberg-Nilsson et al., 2015). In this method, each role is represented by a hat of a particular color. Each color or hat represents a specific perspective of thinking, enabling a systematic separation of the different aspects of the discussion and focus on one perspective at a time (Wikberg-Nilsson et al., 2015).

The Six Thinking Hats method was used to refine and analyze the concepts generated in Sections 4.5.1, 4.5.2, and 4.5.3. This approach provided a structured framework for concept development while allowing for a thorough evaluation. Since only two participants were involved, and six hats needed to be considered, roles were rotated to ensure that each perspective was represented. The hats included: (1) *White*, facts and numbers; (2) *Red*, emotions and feelings; (3) *Black*, risks and weaknesses; (4) *Yellow*, positive and optimistic; (5) *Green*, creative and innovative; (6) *Blue*, control and management (De Bono, 1988; Wikberg-Nilsson et al., 2015). By adopting these perspectives, concepts were approached from different angles, leading to new insights on how to refine or eliminate ideas with less potential.

The structured nature of the method reduced unproductive discussions and helped maintain focus and efficiency throughout the session. By the end, previous concepts had been successfully filtered and refined into viable solutions, ready for further development and sketching in the next stages of the design process.

4.6 Wireframing

Wireframing is a prototyping technique used early in the design process to visually communicate an outline of an application (Lloyd, 2009). Wireframe prototypes can be used to collect user feedback before committing to and finalizing a design, and according to Sutipitakwong and Jamsri (2020) save both time and expense.

4.6.1 Low-Fidelity Wireframing

Low-fidelity wireframes are rough sketches that serve as the initial visual representation of a designer's ideas. They feature simple layouts and placeholder elements and colors are often only black and white with limited detail (Santoso, 2024). The author explains that low-fidelity wireframes are employed to assist designers in presenting interface information, providing an outline of the interface structure, and consequently accelerating the design process.

The wireframes were based on the User Flow Diagrams (Section 4.4.3) which were created from insights from the Interviews (Section 4.2.2). These user flow diagrams acted as a solid foundation of interaction flows and provided information on necessary components.

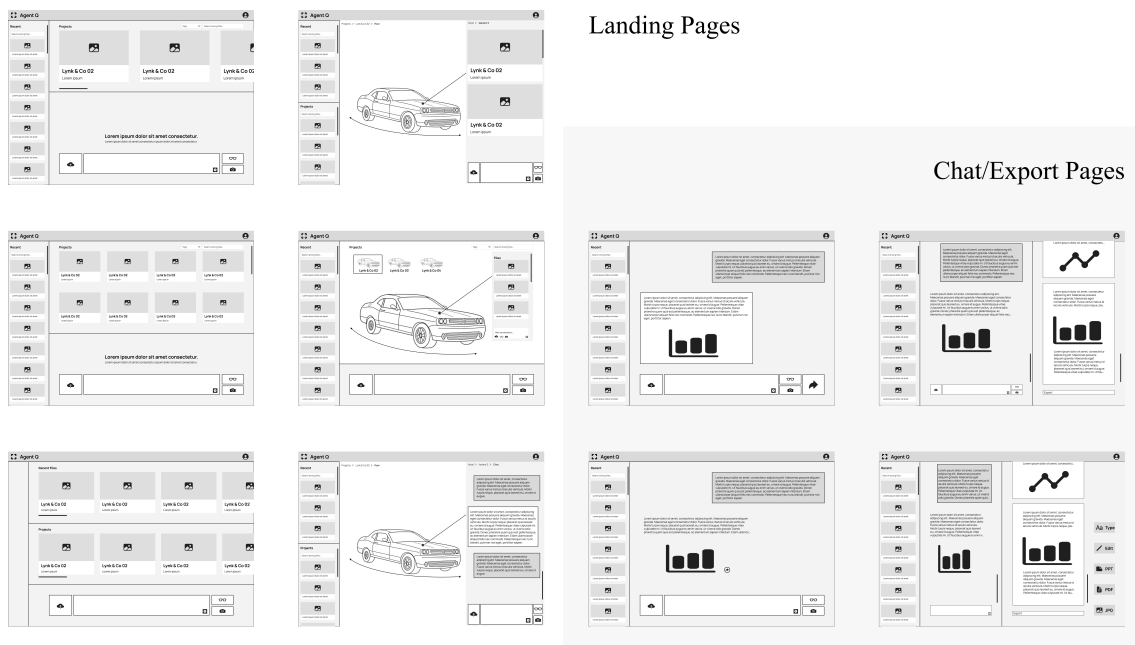


Figure 4.6: Low-fidelity wireframes illustrating proposed landing page layouts (left) and chat/export functionalities (right) of the AI agents interface.

During the ideation phase (Section 4.5), early concepts of the UI interface design began to emerge in fragmented sketches and notes, made by hand. The sketches were subsequently translated into digital format in Figma, a collaborative digital tool for the design of user interfaces (Figma, n.d.). These low-fidelity UI wireframes were organized and grouped into categories such as Landing Page, Chat Page, and Export Page (see Figure 4.6). Categorizing the elements helped us refine our ideas, merge overlapping concepts, and eliminate redundant ones.

4.6.2 Wireflows

Wireflows, which are a combination of wireframes and user flow diagrams, were used to connect the user workflows to the visual elements of an interface. While user flow diagrams are used to communicate workflows, they leave out the context of the interactions (Laubheimer, 2016). Laubheimer continues to explain that, on the other hand, wireframes showcase the context of interactions but are static, and do not describe the interactions between the user and the system. Combining these two methods allows designers and evaluators to make use of the advantages of both methods. According to a study made by Guerino et al. (2024), wireflows can help professionals gain a better understanding of the users, better direct the development process, and reduce the amount of work that has to be redone.

Several wireflows were developed in Figma based on the low-fidelity wireframes described in Section 4.6.1. However, they were heavily reduced in information and were treated as components. Several combinations were ideated during the process, and the most plausible wireflows were refined and are presented in Figure 4.7. These wireflows were used to illustrate how users would interact with the AI agents at different stages of the workflow.

4. Methods and Processes

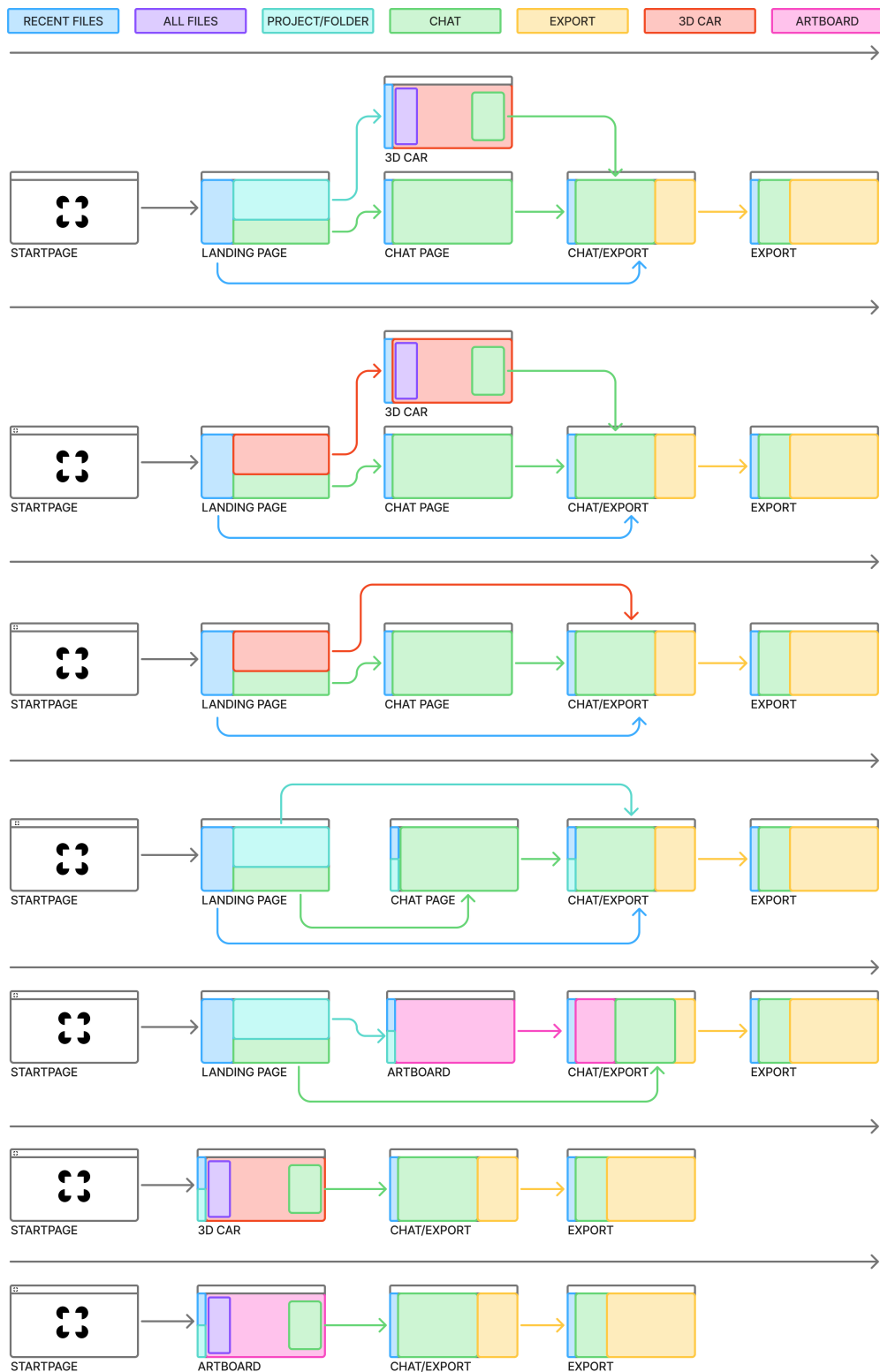


Figure 4.7: Overview of seven interface wireflows illustrating alternative user navigation concepts for the AI agents.

4.6.3 High-Fidelity Wireframing

Creating high-fidelity wireframes gave us a middle ground between the early concepts and the final design, giving us a more accurate representation to evaluate and configure. It also provided us with a foundation for later building a functional prototype.

The high-fidelity wireframes were developed in Figma and had a higher level of detail than earlier iterations. At this stage, key interface components such as the chat box were finalized, drawing inspiration from a market analysis of existing AI chatbot interfaces. The overall information architecture also began to take shape, with screen layouts designed to support the intended user flows. As shown in Figure 4.8, three concept variations were created. The first concept uses a three dimensional vehicle model as an interactive file organizer, where clicking on a specific part reveals all related files and conversations. The second concept uses a more conventional layout with a clear and structured hierarchy. The third introduces an infinite artboard-style organization that allows for flexible spatial arrangement of content. All three concepts eventually end with an export window, designed to streamline the process of compiling and sharing insights and media from conversations.



Figure 4.8: Three high-fidelity wireframe concepts illustrating alternative layouts and interaction flows for the AI agents interface.

4.7 Prototyping

Building on insights from the wireframing phase, insights from the qualitative study, and the resulting design guidelines, a high-fidelity prototype was developed using Figma. This prototype aimed to translate theoretical recommendations into a functional and visually coherent interface. Client-specific branding and design guidelines were incorporated to ensure consistency and alignment with Intended Future’s identity.

The prototyping process had several purposes. First, it served as a way to implement and test the proposed guidelines in a tangible form, allowing their practical implications to be assessed and refined. Second, it provided a communication tool to showcase the guidelines in practice and support dialogue with stakeholders, enabling them to better understand the envisioned functionality and flow of the AI agent.

Given that the AI agent was primarily intended for use in desktop-based workflows, the design process prioritized desktop interactions over mobile applications. This decision made sure that the prototype aligned with the usage scenarios of the target user group.

4.8 Ethical Considerations

This study was conducted with consideration of ethical research practices to ensure the protection, dignity, and autonomy of all participants. Prior to each interview, participants were informed about the purpose and scope of the research, how their data would be used, and their rights, including the right to withdraw at any time. Consent was obtained in writing before data collection began. The participant information and consent form are found in Appendix A.

All identifying details were removed from transcripts and quotations to ensure privacy and confidentiality. Interview recordings were transcribed using a locally installed AI tool (aTrain), which operated entirely offline to protect the data. Transcripts were manually reviewed and corrected to ensure accuracy. All data were stored securely, accessible only to the research team.

5

Results – Part I: Thematic Findings

This subsequent chapter introduces the first of two results chapters and presents the findings of the thematic analysis of interviews with automotive designers. The findings offer insight into automotive designers’ workflows (section 5.1), challenges (section 5.2), Current and Emerging Use of AI (section 5.3), Industry Readiness to AI Adoption (section 5.4) and Barriers to AI adoption (section 5.5), and the identified Desired Features of AI Agents (section 5.6).

5.1 Understanding the Automotive Design Process

The design process in the automotive industry is multifaceted and varies across organizations, but several phases are consistent. Participants described a progression from broad research to ideation, prototyping, and iterative evaluation. As one designer explained “*Starting with kind of a broad research*” (P10). The early stages often involve a briefing and counter-briefing phase, where project goals are broken down and clarified “*then you will do a counter-brief where you try to dissect it and make it more digestible*” (P2). Following this, the process transitions into ideation, where initial concepts begin to take shape, “*we can start from an idea... then... draw a sketch of this idea*” (P8). After ideas are developed, prototyping allows designers to translate the sketches and try them out, “*And after that... we go forward by building a first demonstrator.*” (P8).

Throughout this journey, evaluation is deeply intertwined. Designers continuously assess concepts during development and collaborate closely with other stakeholders, “*When the first plastic parts comes out from the tool, then we do our first assessment [...]. But before that, we sit together with the designers and the engineers to see if the drafts are okay.*” (P6). Refining the concepts continuously is a “*And then we try the design detailing. We try to work on the form, the function*” (P2).

The workflow is rarely linear. Instead, it is described as highly iterative, characterized by frequent loops between ideation, evaluation, and refinement, “*some ideation and refining of the concepts and then getting back to... research... or to the users to evaluate the concepts*” (P9), “*evaluate them, iterate, and then final product*” (P12). This cyclical and iterative approach reflects the experimental nature of automotive design. The insights gained at each stage frequently redirect to earlier phases, underscoring the value of adaptability, effective communication, and the necessity for structure.

It also became evident that the result of the design process is shared and presented. A participant said, “*We very often have to send reports*” (P2), and another “*Some kind of report with like images because that’s usually how you present stuff*” (P4).

5.2 Challenges in the Automotive Design Process

Despite the established and structured nature of the design process, participants highlighted several challenges within the automotive design process. As shown in Figure 5.1, the lack of knowledge, limited user feedback, and reliance on subjective judgment hinder confident decision-making. The following section describes these challenges in more detail.

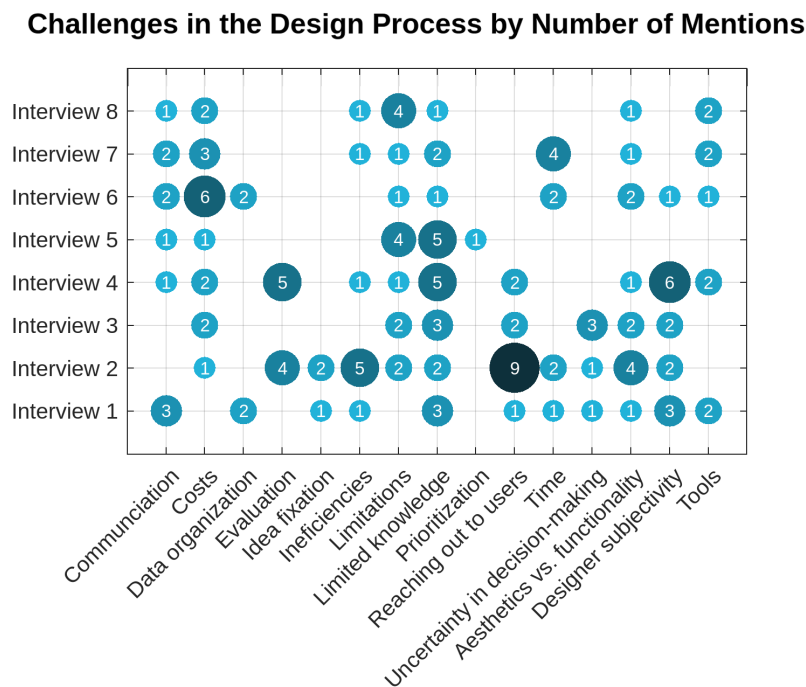


Figure 5.1: Frequency of challenges in the design process mentioned in the extracted quotes.

5.2.1 Measuring Design Quality

The study found that many of the challenges in the design process stem from not being able to measure how good a design is, with one participant saying that *“there’s never really any good way to evaluate design”* (P11). Evaluation metrics are often unclear or inadequate; *“it always feels like measuring if it was a success or not is very vague”* (P11). Defining measurable success criteria was a core challenge that designers strive to find, with one interviewee stating that *“we don’t know what quality is. That’s what we’re trying to figure out all the time”* (P2).

Because of the inability to measure design, there was a lack of tools for design evaluation. *“I don’t use any specific tools at least”* (P1), one participant stated, with another not being aware of any tools, *“I don’t know if there are any tools or methods for that”* (P9). There were cases in which tools were used, not used to measure design, but rather to measure specific criteria, such as the CO2 footprint of the material used, and to measure the color accuracy of finishes. In general, designers expressed a need for better evaluation methods: *“Do I feel that there is a gap? A gigantic gap!”* (P2).

In the absence of objective measurements and tools, participants unanimously described automotive design decision-making as being heavily subjective. While teams need to consider factors like time, costs, aesthetics, and functionality, ultimately, the evaluation of a “good” design often comes down to designers’ and decision-makers’ instinct and experience. *“It’s a gut feeling... driven by experience”*, one interviewee said of judging design quality (P2). One designer derived it from *“due to [design] being subjective in many ways”* (P11) and that it varied between individuals: *“it’s a lot of subjective evaluations, of course and I mean different designers have different opinions and different backgrounds”* (P4). Some acknowledged that *“It’s very subjective, unfortunately”* (P2) and *“I think it’s usually the team or us as designers are kind of the judges[...], which might be a problem sometimes”* (P10). One designer gave a vivid example of how their designs were evaluated: *“We receive comments and feedback based on how the wind is blowing and [how the management team] woke up in the morning”* (P2). Such variability made it challenging to confidently decide if a design is meeting the intended goals.

User evaluations were viewed as one of the few ways to counterbalance subjectivity in design evaluation, providing more grounded evidence about how a product is perceived and used. Several participants emphasized their value, noting that feedback from real users can validate if a design is in line with what the market wants: *“If*

they don't like it, they won't buy it" (P5). However, executing user evaluations in the automotive context presented several challenges. One challenge was the time and cost related to evaluating with users, but even with the needed resources, the secrecy of the automotive industry provided obstacles. One participant explained that the company had to rely on user evaluations that *"were not exposing customers or potential customers to any sort of design possibility"* (P2), and another said that there are *"No, sort of controlled ways where we get those kind of inputs so easily"* (P1). In many cases, teams had to rely on feedback from prior projects rather than engaging with target users during development: *"Customer complaints is the one that sometimes gets into our department"* (P1) and for several designers, user feedback did not reach them at all: *"I don't get very much customer information to me"* (P4). However, most designers expressed a desire to involve users more in the design process.

Given the difficulties in measuring how good a design is and the subjectivity in decision-making, many participants expressed a desire for more objectivity in their process. They struggle to back up decisions with data, and a few mentioned attempts to introduce metrics or heuristics. One interviewee observed that *"they would actually benefit in having [a] more objective way of measuring [design quality] rather than only subjective"* (P2), and another said *"I think it would be very interesting to have some data"* (P3) in the context of evaluating design quality. One expanded on the topic *"I think that there is an interest on having more data informed design process, not only decision-making, but the whole design process. I think that everyone would love to have that. It's just too tedious and scary"* (P2). This sentiment reflects a core need: a data-informed design workflow should help provide evidence or consistent criteria, without stifling the creative and experiential intuition that designers value. The challenge is to augment the gut feeling with data-informed insights, so that decisions aren't left solely to *"personal subjective... bias [or] culture"* (P2).

5.2.2 Information Gaps and Sustainability Data

Another challenge within the design workflow was the difficulty in accessing reliable and comprehensive information, particularly when projects require interdisciplinary or supplier-dependent data. Several participants mentioned they sometimes operated with insufficient knowledge. As one designer admitted, *"You are lacking some knowledge and you can't really access that knowledge. So sometimes you have to take qualified guesses"* (P9). These knowledge gaps were caused by a lack of access to the right people and information, and the time needed to get hold of this expertise.

One respondent noted the burden of compensating for knowledge gaps within their own organization: *“I have to educate and sort of build up the use of CMF for them. They are not so used to using design at all”* (P1).

A specific and recurring pain point concerned accessing sustainability data, particularly CO₂ emissions data from suppliers. This issue was especially prominent when trying to compare or validate material choices. *“It’s very difficult to get some clear data from the suppliers”* (P3). One designer elaborated on the complexity of CO₂ reporting, noting that *“the results can be totally different from one methodology to another one”* depending on how assumptions are made in the calculations (P3). Another participant emphasized the inconsistencies across the supply chain: *“We can have for the same parts one supplier in France, one supplier in China... the energy mix is totally different. The transport will be different... We need to be able to work with much more precise values”* continuing with *“Some OEMs consider leather a scrap from another industry, others say no, we need to consider CO₂ from the life of the cow... at the end, yes, it’s very, very different result”* (P3). The transparency, inconsistency, and inaccessibility of supplier data severely limit the ability to make informed design decisions.

5.3 Current and emerging use of AI

Among the interviewees, there was a mix of excitement and hesitancy about using AI tools in design. Several designers have begun experimenting with AI in the early phases of design, treating it as a creative assistant to spark ideas *“it’s a good start to create like concepts ideas from the beginning”* (P4) or to handle routine chores *“in my sustainability activities, I’m using it a lot.”* (P8). *“ChatGPT is probably the most used [tool] for a lot of things, like bouncing ideas, get some help in ideation and things like that”* explained one participant (P11). Designers reported using generative AI to overcome blank-page syndrome and explore a wider range of concepts quickly, *“when you have a blank canvas, to get a push start”* (P12). For instance, one participant described how, when starting a new concept, *“if you’re stuck and you don’t really know how to tackle the project, AI can help “drive the work forward”* by suggesting fresh approaches (P11). Others have used image-generation AI to visualize ideas, *“generating AI pictures... give other people a grasp of what we were thinking it was going to look like”* (P12), which helps communicate concepts to team members and stakeholders. Another noted they use AI tools *“to do rapid research and to get some sort of well-phrased bullet points that are useful in a PowerPoint”* (P2), speeding up the gathering of information, similar to another participant using AI tools for

“organizing the insights that you have gotten and... summarize it” (P9). What became evident is the lack of use of AI tools in the later phases of design, *“We don’t use it for optimization in the end”* (P2).

This integration of AI tools is already creeping into the designer’s toolbox and has become a source of inspiration, quick visualizations, and information retrieval, aiding designers during exploratory tasks and alleviating designers from some of the more tedious tasks, citing one of the students and future designers *“It shortens the time that you’re on tedious tasks which doesn’t require a lot of creative thinking, which just has to be done. I think that’s how you use it nowadays”* (P11).

However, the adoption of AI tools is far from uniform. Several interviewees admitted little to no firsthand experience with AI in their workflow. *“I haven’t used any AI tool whatsoever,”* one designer stated (P1), while another said, *“I’m not using any... not that I know, never used ChatGPT”* (P6). This hesitation often stemmed from uncertainty about the benefits or a comfort with established tools, *“today we are using internal Excel files, so not so much AI oriented”* (P3). One participant reflected, *“I’m pretty slow like adapting to stuff, so it could be that if I just start using it and see the benefits of it like many of us do, then maybe I would like it”* (P4). Comments like these suggest an openness to AI once its value is proven, even among those currently on the fence.

5.4 Industry Readiness to AI Adoption

During the interviews, it quickly became evident that the automotive industry is, in general, ready for AI adoption. Many participants described it as the natural next step in the evolution of their work. As one designer explained, *“I think it’s widespread in the design department because it’s also built in... the way of thinking when you’re working in the design department because we are working in the future, so I mean the same people are adaptable as well”* (P5). Others even described AI as an already existing practice, particularly in generative applications: *“When it comes to generative AI... it’s already been used and the designers can see the benefit in adopting, substituting some of their functions into it”* (P2).

A few interviewees are more hesitant and see it as a necessary step, one participant stated, *“I think [the automotive industry] have to... they have to use it”*, continuing *“We should move forward. That’s for sure”* (P8). Another participant explained that whilst she is more hesitant, she sees the industry and her colleagues adapt *“It feels like most of the people I talk to they are keen on using AI [tools]... and have*

more experience of it and have seen what you can create and get out of the system and probably see more benefits” (P4).

In an interview with Design Quality Specialists, they reflected on the impact of AI tools on their workflow. One noted, *“Hopefully, it would save time, but at the same time, I think that it sometimes eats more time, so the benefits can also be the disadvantages” (P7)*, highlighting a potential paradox in the implementation of AI technology. A colleague continued, *“But right now we are a bit, we don’t really know what to do with this information, and we can’t see very clear benefits” (P6)*, pointing to an uncertainty about how to effectively apply AI in their practice. They added, *“We haven’t understood it before this, that we maybe can use it” (P5)*, suggesting that awareness and understanding of AI’s potential remain limited within the team. However, despite this uncertainty, there appears to be growing enthusiasm: *“It’s a big interest from the younger persons and also from management, in the hierarchy [pointing up]. Everyone wants to be involved in new stuff, I want to learn more” (P7).*

In addition to technical uncertainties, several participants raised cultural and perceptual challenges. A well-experienced designer who uses several AI tools daily explained that his team *“are in that phase where we’re trying to convince people that it’s not just lazy work. Clearly, there is a degree of lazy work, but it’s not necessarily only lazy work” (P2)*. He emphasized their ongoing effort in *“making people understand that it’s not just, I mean, using it is faster, but it still requires a lot of work. And it’s an art and a craft by itself” (P2)*.

5.5 Barriers to AI Adoption

While there is optimism about the potential of AI in the automotive industry, it has also become clear that the adoption of AI would not be without any barriers. As illustrated in Figure 5.2, the main pain points of the adoption of AI by designers regard concerns about reliability, privacy, a fear of replacement, control, and capability limitations.

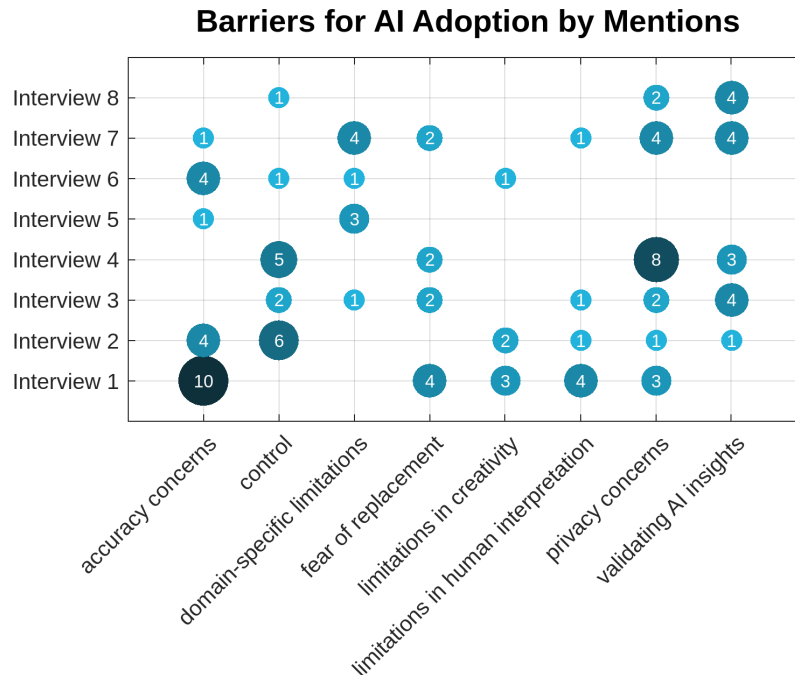


Figure 5.2: Barriers to AI adoption ranked by frequency of mention in the extracted quotes.

5.5.1 Reliability

The interviews revealed skepticism about the reliability of the AI agents’ suggestions. Participants repeatedly emphasized that they would not entirely trust an AI tool’s assessment without any verification. *“If I’m imagining insights, kind of a domain of the design process, that area requires a lot of sources to be controlled and validated. That part, that type of the job will still have to be done in a way”*, explains one designer (P2), emphasizing that AI-generated insights might not instantly provide the level of validation and accuracy required for confident decision-making. Another designer shared a similar concern: *“I would be quite skeptical at first, I think. I wouldn’t be sure that this is fine”*, adding that he would prefer to verify AI suggestions himself: *“I would probably want to test [AI suggestions]... to see like a correlation. And maybe if... they said basically the same thing, then I would be*

more secure” (P12). This cautious relation to the AI suggestions were shared among the participants; “*we wouldn’t trust it without checking it if we think it’s right*” (P5), and “*from my initial point of view like if a tool like this was created I would use it more like an indication than like a correct answer or like a actual result*” (P4).

However, participants also acknowledged that trust in AI systems could increase once the tool has consistently demonstrated value. A participant explained that her research database and choice of AI tool provided the same answers which increased the acceptance; “*I have a tool, a dedicated tool, where the research database and Claude [an AI tool] has the same level of values [...]. So it makes me feel comfortable to use it*”, further noting that “*In the beginning... that’s what you would do [validate]. And then, if it was the correct answer for a while, then you would accept the AI insights*” (P8). Another participant said, “*You need to build up a trust. For how long should we check it and it is approved... for us to rely on it?*” (P6), highlighting that trust and acceptance are something that needs to be earned. Therefore, it is essential to establish trust in the AI’s suggestions. Users remain wary of AI until it has consistently demonstrated its accuracy and value over time.

Several participants expressed concerns that AI might overlook critical nuances in the design process. “*I would be much more worried of [AI] missing something in the analysis... than if I would have gone through everything myself*”, said one designer (P10), fearing that important details or context could be lost. Another noted the potential detachment in AI-produced content: “*You can get information really fast uh but I also feel at the same time that you’re losing... the human touch*” (P4). Similarly, a participant compared it to difficulties in human communication, observing: “*I know what happens when you try to give some thoughts to others without doing sketches and stuff like that. And it’s super hard to make them understand. So I guess it’s going to be super hard to make a computer to understand what you mean*” (P1).

A common conception was that current AI tools can produce answers that appear convincing but may be incorrect or irrelevant, requiring human oversight. “*You often have to look through it because they’re not always relevant*”, one participant noted regarding the use of generative AI tools (P11). This need to manually review outputs was seen as undermining the efficiency gains that AI is supposed to deliver. As one participant put it, if you must “*go through everything on your own just to make sure it was correct*”, that feels “*inefficient*” (P9).

5.5.2 Privacy and Data Security

A recurring topic across interviews was privacy and data security. In the highly sensitive and competitive context of the automotive industry, the handling of design information and Intellectual Property (IP) is of great concern. As one designer emphasized, “*Security, I would say that that is really, really big. . . we need to keep track of what we are sharing and who can see and who can take benefits of our work*” (P7). Another participant articulated a similar concern, identifying “*the major risk or the major fear is how to not share with anyone else*” (P1). When it comes to early-stage concepts and innovations, these concerns are most notable. As one interviewee pointed out, “*If [designers] put up new ideas about upcoming products, then what if this gets compromised and their competitors get access to that?*” (P9).

Beyond general fears of data exposure, the adoption of AI tools is also limited by internal policies and physical boundaries. Companies often restrict access to cloud-based tools and generative platforms. As several designers explained: “*We use them [AI tools] internally with the material that is not sensitive*” (P2); “*We are not allowed to send pictures*” (P5); and “*We are not allowed, even as employees, to use our phones or private devices or anything that is connected to the interwebs*” (P2). These restrictions constrain the contexts in which AI tools can be used, particularly in tasks involving visual materials or confidential design content.

To mitigate these risks, participants emphasized the importance of combining the advancement of technology with robust protection. “*High development has to be associated by a secured system*”, one participant stated (P8), emphasizing that AI systems will only be adopted if they meet high security standards.

The interviews also revealed a tension between the desire to gain insights from others and the hesitation to share one’s own data. “*I want to have everyone’s information, but I don’t maybe want to share so much*”, one participant admitted (P1). This illustrates the ambivalence shared by many designers toward AI. One designer expressed a common fear “*Designers are concerned about where are these designs going to go and who is going to be stealing my design, my ideas*” (P2). At the same time, a slightly different concern about the integrity of the creative process itself appeared. As one participant put it, “*AI tools [are] doing like replicas of others’ work because it’s based on data on what it has seen before. So like plagiarism[. . .]. Maybe not getting completely original designs*” (P12). This reflects a broader dilemma between openness and protection. AI systems thrive on data, but that data is often too sensitive to be widely shared.

However, views on privacy were not entirely uniform. While many participants expressed strong concerns, others were more relaxed about surveillance or data sharing. As one designer student stated, *“I don’t care if it’s watching you. I wouldn’t think too much about that”* (P11). In contrast, a seasoned designer emphasized that the stakes are only increasing: *“It has always been a high level of security in the design department because you don’t want to leak out, you don’t want to spoil, but now it’s even, even more important”* (P7).

5.5.3 Fear of Replacement

Another common barrier to AI adoption was the fear among designers of losing control over their creative processes and even their roles. Many interviewees stressed that an AI should augment, not replace, the human designer. This reluctance of AI adoption and fear of replacement is shared across the industry, *“I would say that if you go into the domain of between the brackets, stealing jobs from designers... you will get a lot of reluctances from the designers”* (P2). Designers expressed feeling threatened by the potential of AI systems: *“little bit of a threat as well,”* one remarked, elaborating further, *“maybe that we are not so interesting any longer. We as designers, we’re not so special. Everyone can sort of go in if [the AI tool] learns too much”* (P1).

A design quality specialist acknowledged this unease, noting that the increasing use of AI tools was questioning traditional practices: *“There’s a big change... with all this AI, and we are getting quite questioned how we do stuff, why we do it, how we can do it easier, faster, more efficient, and it’s a bit tricky for us right now”* (P7). Despite these concerns, designers also expressed a desire to improve their workflows. As one explained, *“of course we want to do stuff easier and more efficient, but we have also worked in this process for many, many years and made it as efficient as possible with the tools that we have today. And sometimes we can find it a bit abstract that an AI can take over everything and do it even more efficient”* (P7).

Underlying these tensions is a cultural attachment to the creative identity. As one designer observed, *“The most challenging part is how do you convince a well-seasoned designer that that aura is not enough... that your tool is an add-on to the aura somehow”* (P2). This statement encapsulates the broader challenge of positioning AI as a supportive presence in the design process, one that enhances the designer’s role and identity.

5.5.4 Loss of Control and Creative Identity

During the interviews, it became evident that the role of designer is associated with a sense of pride, control, and personal authorship. As one participant explained, *“I would rather do it myself because otherwise I didn’t do it”* (P11), adding *“it’s an AI who did it and I think that’s a barrier for a lot of people”* (P11). This role of creative identity, or what several participants referred to as the designer’s ego, is for many designers, closely tied to personal authorship. This makes the introduction of AI tools a sensitive issue. One participant reflected on this tension, suggesting that, *“I think designers [have] to adjust to the fact that... letting go a little bit of their ego”* (P11). At the same time, others were seeking ways to integrate AI without compromising personal expression. As one designer noted, *“I’m still trying to allow for the designer ego to shine through”* (P2). This suggests that successful adoption of AI tools depends not only on functionality and trust, but also on whether the AI tool allows for designers’ personal expression to remain visible.

5.6 Desired Features of AI Agents

Participants expressed several fundamental needs that AI tools must address to provide desired support in the design process. These include the demand for data-informed insights, transparent system behavior, supportive collaboration modes, and intuitive interaction methods. The subsequent section will cover these needs in greater detail.

5.6.1 Data-Informed Insights

A recurring theme across interviews was the need for AI agents that support data-informed design processes. Automotive designers frequently described working under conditions of ambiguity or subjectivity, emphasizing the value of data in providing clarity and confidence in decision-making (subsection 5.2.1).

While AI is often associated with generative tasks such as ideation or visual rendering, several participants expressed the need for a stronger focus on analytical and evaluative capabilities. As one designer remarked, *“Everything connected to numbers and technical solutions rather than using AI to create... that’s more towards the designer’s side”* (P4). The demand for data extended to aid in strategic and evaluative decisions. One participant explained, *“What is important is really to speak with data”*, continuing, *“We need data to convince you, and without that,*

it will not be possible” (P3). Designers highlighted the importance of data not only for internal validation but also for communicating insights to stakeholders.

A particularly resource-intensive challenge identified was obtaining meaningful user input. One designer observed, *“Something that always is time consuming is getting out to users and getting user input [...] So if you could get good data on that, which you could use, that would be probably the most suitable [function]”* (P11). These comments reflect both the essential role of user research and the practical barriers to conducting it effectively.

5.6.2 Transparency and Explainability

Alongside the need for data-informed insights, designers placed significant emphasis on transparency as a requirement for AI tools. Without understanding how an AI system produces its output, designers expressed difficulty trusting or integrating its suggestions into their workflow. The participants insisted that the system should reveal its sources and confidence. For example, a designer appreciated that some AI assistants cite their information: *“In Copilot [an AI tool]... when it gives you a fact then it has the source and you can see... ‘oh, I’m not really sure if this is a good source’... That’s good”* (P10). Having traceable references allows the user to verify and judge the credibility of the AI’s input, which in turn builds trust. Another interviewee expanded on this idea, suggesting that the interface should explicitly communicate the validity of its data: *“presenting the... validity of the sources and having a very transparent policy on where the information comes from, which type of customers you’ve been parsing the information from... That kind of security report could be part of the report itself as well”* (P2). In essence, users want an AI agent that behaves like an expert assistant: open about its evidence and even its uncertainties. Rather than being too confident, the AI should acknowledge ambiguity when it exists. As one designer said, if the AI is *“more honest, like ‘I’m not really sure here,’ then I can take that part and make it better”* (P9), allowing humans and AI to collaboratively reach a solution. By designing the AI’s interactions to include explanations, source links, and confidence levels, the system can position itself as a trustworthy partner. This transparency, combined with the opportunity for users to verify results, was seen as essential for overcoming the initial skepticism and ensuring the AI tool’s insights are taken seriously in the design process.

5.6.3 A partner, Not a Replacement

Participants agreed that AI tools should act as supportive collaborators and reflect designers’ desire to retain creative control: “*But you don’t want it to decide everything*” (P11), one stated, and another continued, “*It shouldn’t be the last one touching the keyboard*” (P12), contributing meaningfully but staying in the background. As one designer put it, the AI should help in “*nurturing, I would say, a culture of design that is not only based on crafting good prompts*” (P2). The participants wanted AI to be helpful aid rather than a replacement: “*For me, AI should be some sort of, not a replacer, but a help*”, continuing on the topic that it should be “*more of a support and assisting tool than to sort of design things*” (P1).

Designers also voiced preferences about the agent’s tone. It should be “*inspiring but also professional*” (P10), one participant stated, and “*just that it doesn’t feel cold and boring is the main thing I would say*” (P9), another said. While some were open to human-like assistants: “*To see like it’s an assistant, it’s basically a person*” (P12), others clearly stated that they “*would not prefer it to try to seem like a human person*” (P10).

5.6.4 Collaboration and Private Space

Designers also emphasized the duality of their work. While design is often a collaborative process, many aspects require solitary reflection and iteration. As a result, an AI agent must support both modes of working. Several participants expressed the desire for collaborative platforms where designers and other stakeholders could share input and build upon each other’s insights. For example, one participant noted “*a lot of people in the product have ideas around the same things but maybe they don’t really come up to the surface*” (P10) and another said “*You need to find the latest stuff and you need to know what other people has been doing*” (P2). Several participants also pointed out that a collaborative space could aid in easing communication. One designer said that the “*phase of documenting yourself or handing over to somebody else or receiving it... is always problematic*” (P2).

Participants put forward the importance of producing outputs that facilitate communication with stakeholders. Designers noted the need for outputs that are not only functional but also visually and structurally appropriate for meetings and presentations: “*Some kind of report with like images because that’s usually how you present stuff, you cannot only have a boring Excel sheet on the meeting*” (P4).

At the same time, designers strongly valued the need for private working modes, particularly in early ideation stages. Sharing incomplete ideas too early was seen as uncomfortable or counterproductive. As one interviewee stated, *“I see a use of the collaborative space but then I think it’s also important that you still have your own space and that they can’t really invade. . . you’re not really proud of those [ideas] then you don’t want someone invading your privacy”* (P9).

5.6.5 Preferred Interaction Methods

When it comes to how designers interact with AI agents, most preferred using natural language through text, *“Me I prefer to type”* (P8), one designer stated simply. Voice input was often dismissed as less practical in workplaces. One participant said, *“I think voice is difficult in the work environment”*, further explaining: *“I think that people are too concerned of sounding weird”* (P2).

The designers also expressed interest in expanding input modalities beyond text. One participant suggested, *“I would say a possibility to upload images or maybe even CAD data, that would be interesting, and then you have like a text field underneath where you ask the questions”* (P4). When discussing the potential of live video input, one participant said: *“Maybe some [AR] glasses because sometimes it’s hard to get the defects that you see on camera”* (P6), but most participants stated that they would prefer using their phone for practical reasons. However, concerns about corporate security policies were also highlighted. As an interviewee noted, *“If you could choose between live video or a video from your phone, let’s say, or if you could have those glasses that can take videos, well, [they] are both going to infringe the policies that we have in our office”* (P2).

5.6.6 Information and Asset Organization

Beyond interpreting external data, designers expressed frustration with managing their own project files and research materials. Participants frequently described a need for better organization tools within AI systems. For example, one participant noted, *“Now I think for ChatGPT, you can see your history, but it’s just like the long list, so it’s very hard to find things. If you could create folders or something that you’re used to, it would be helpful”* (P10). The designers requested organizational features such as folder organization, tagging of files, smart search for content within conversations, adding thumbnails to folders and conversations, and being able to name files as they wanted. Designers wanted AI to help them not only locate information quickly but also keep track of resources over time: *“If you use it on a regular basis, I mean in a month you will have a lot of chats open and finding that content implies that you’re just crawling around”* (P2).

6

Results – Part II: Synthesis and Application

This chapter initially presents nine actionable Guidelines for Designing User-centered AI Agents (section 6.1), derived from the main findings of chapter 5. The chapter then presents a concrete application of the guidelines in the form of a proposed interface concept for the AI agent tailored to support perceived quality evaluation in the automotive industry (section 6.2).

6.1 Guidelines for Designing User-centered AI Agents

The subsequent section will present guidelines for the development of AI agents in the automotive industry. While some of the guidelines are more oriented towards designers within the automotive industry, they may apply to other practices and industries. The guidelines are derived from and motivated by the findings of the thematic analysis of the interviews.

The guidelines are part of the results of this thesis project and aim to answer the following research question:

RQ: *How can AI tools be designed in a user-centered way to support automotive designers in their workflows and decision-making?*

The following nine guidelines for designing AI agents in the automotive industry are presented in no particular order.

Guideline 1. Ensure Transparency

AI agents must be transparent, clearly communicating the reliability and validity of their insights and the data on which they are based. This is critical to building trust and enabling the adoption of the AI agent.

Transparency was repeatedly emphasized by participants as essential to building trust. Users need to understand how the AI assesses design by showing what data it draws conclusions from, how confident it is in its assessments, and whether its results are speculative or based on concrete evidence. When users can understand the logic behind a suggestion, they are more likely to trust and adopt the tool into their workflow.

Guideline 2. Support Both Individual and Shared Workspaces

AI agents should support both private, individual workspaces and shared, collaborative workspaces. This encourages creativity in individual work while improving communication and handovers through the collaborative space.

Participants expressed the need for both individual and shared workspaces. In general, private spaces were preferred for exploratory design tasks because of the fear of judgment from others in the early stages of the design process. At the same time, however, participants emphasized the value of shared spaces to improve communication between individuals/teams and to support design reviews. Supporting both modes respects the individual, but also simplifies rather than complicates communication.

Guideline 3. Ensure Data Privacy and Transparent Communication

In addition to protecting sensitive data and providing local processing options, AI agents must clearly communicate to users both potential risks and reassurances about non-risks to build user trust and reduce unnecessary concerns.

Concerns regarding privacy and confidential data leakage were prominent among automotive professionals. Users wanted assurances that using the AI tool would not compromise intellectual property or inadvertently train the AI models for use by others. In addition to complying with data privacy standards, the system must clearly communicate to users how information will be stored, processed, and shared. Trust in privacy is built not only through technical solutions but also through transparent communication, increasing the adoption rate of the tool.

Guideline 4. Provide Flexible Inputs and Compatible Outputs

AI agents must support textual interaction. To fit into users' existing workflows, multiple input methods (e.g., voice, images, video) should be implemented. Outputs should be available in a variety of flexible, easily shareable formats (e.g., slides, PDFs, or editable tables) to increase collaboration and ease handovers.

The users operate in different software environments and interact using different communication styles and channels. Interviews revealed that users preferred to interact with AI agents through text, but for it to be integrated and adopted at scale, it should be compatible with a range of formats, e.g., voice, images, and AR glasses. This allows users to interact with it in ways that align with their current practices. Additionally, the output must be immediately usable in brief meetings or for documentation and decision-making processes, without additional rework. By providing flexibility of inputs and outputs, the AI agents ensure smooth integration into existing workflows, facilitating communication across teams, and reducing barriers to adoption.

Guideline 5. Promote Intuitive File Organization

The interface should support file organization via folders and files with custom naming, tagging, and use of thumbnails, which can be sorted through several filter values. This helps users recall past conversations, manage ongoing projects, and reduce cognitive load.

Over time, users accumulated large amounts of interactions with AI agents. A recurring challenge was the lack of effective sorting and organization features within existing tools. Users emphasized the need for functions that facilitate the systematic retrieval and management of past interactions, to reduce cognitive load and enhance overall usability.

Guideline 6. Enhance Decision-making with Objective Data

AI agents should provide insights grounded in objective data. The use of metrics and standardized frameworks will help users accept insights provided by AI agents and assist them in decision-making processes. A recurring opportunity identified in the interviews was the potential for the AI tools to support decision-making through more objective ways of evaluating design, as opposed to relying on subjective intuition. By providing concrete indicators and data, users can be more accepting of the insights generated by AI and improve their judgment, thereby increasing the adoption of the tool.

Guideline 7. Align Usability with Users' Mental Models

AI agents must demonstrate high usability through intuitive UI design, visual clarity, consideration of user resources, and alignment with existing mental models and workflows. Familiarity with users' current tool habits is essential for adoption.

Despite the promise of AI, many participants had not adopted such tools in their daily workflows, often due to unfamiliarity, unclear benefits, or time constraints to learn a new tool. To address this, AI agents must be designed to look, feel, and behave like the tools users already use. Interface elements should follow established conventions and use visual affordances, such as color-coded feedback. By focusing on usability, the tool lowers the barrier to entry and increases the likelihood of adoption.

Guideline 8. Follow Accessibility Practices

The interface of AI agents should comply with accessibility standards (e.g., WCAG 2.1), ensuring that it is usable by designers, stakeholders, and decision-makers of all abilities and needs.

Accessibility is critical not only for compliance with legal and organizational standards but also for ensuring equitable usability for all users. Applying accessibility principles such as appropriate color contrast, text alternatives for non-text content, and full keyboard operability not only supports users with disabilities but also improves overall system clarity for all users. Applying accessibility practices at an early stage saves costs and future-proofs the tool.

Guideline 9. Nurture the Designer's Ego

The AI agents must act as a supportive partner that enhances, rather than replaces, the designer's creative authority. It should encourage co-creation while ensuring that the final decision remains with the human, preserving their sense of authorship and identity.

Participants expressed concern about losing control or authorship when using AI. While many appreciated the potential for AI to provide insights or design alternatives, they rejected the idea that the tool should take control of critical decisions. To address this, AI agents must be positioned and designed as assistants, not decision-makers.

AI agents should give users the freedom to shape outcomes according to their own judgment and context. Interviews suggested that professionals were more satisfied when they retained control over their work. This not only protects the designer’s ego but is also critical to adoption. Empowering the user builds trust and ensures that the tool is perceived as an enabler of creativity, rather than a threat to it.

6.2 Final Prototype

This section introduces the Final Prototype, which serves as a visual embodiment of the design guidelines outlined in section 6.1. Every design decision is based on the thematic analysis findings presented earlier in chapter 5, ensuring a coherent translation from research insights to interface features. Where applicable, annotated interface images are included to illustrate specific elements of the prototype.

To provide context for the user experience and navigation, Figure 6.1 presents a wireflow diagram, offering an overview of the structure and interconnections between pages.

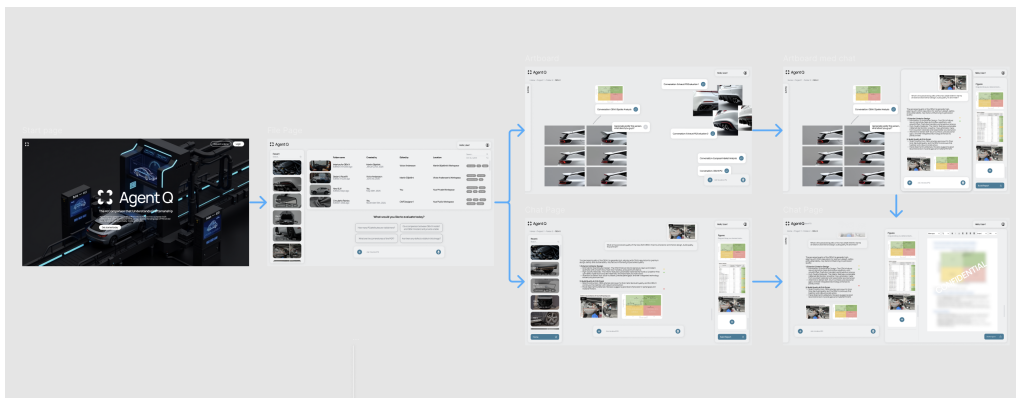


Figure 6.1: Wireflow overview of the final prototype interface, illustrating the user navigation paths.

6.2.1 Start Page

The final prototype opens with a dedicated start page that introduces the AI agent, Agent Q (see Figure 6.2). The tagline, “The AI companion that understands craftsmanship,” is displayed alongside the logo of the client, clearly communicating the system’s purpose and expertise. This phrasing was chosen to frame the AI as a supportive partner rather than a mysterious black box, addressing the transparency guideline (Guideline 1) by explicitly conveying what the AI is and does, addressing

the first requirement of the EU AI Act transparency requirements (European Parliament, 2025). It also reflects a key theme from the interviews: designers wanted an AI assistant that behaves like an expert collaborator, not an autonomous decision-maker, reinforcing that Agent Q is a companion to enhance (not replace) their craftsmanship. It also showcases features of the agent for easy understanding by users. It also clearly communicates the data privacy of the application.

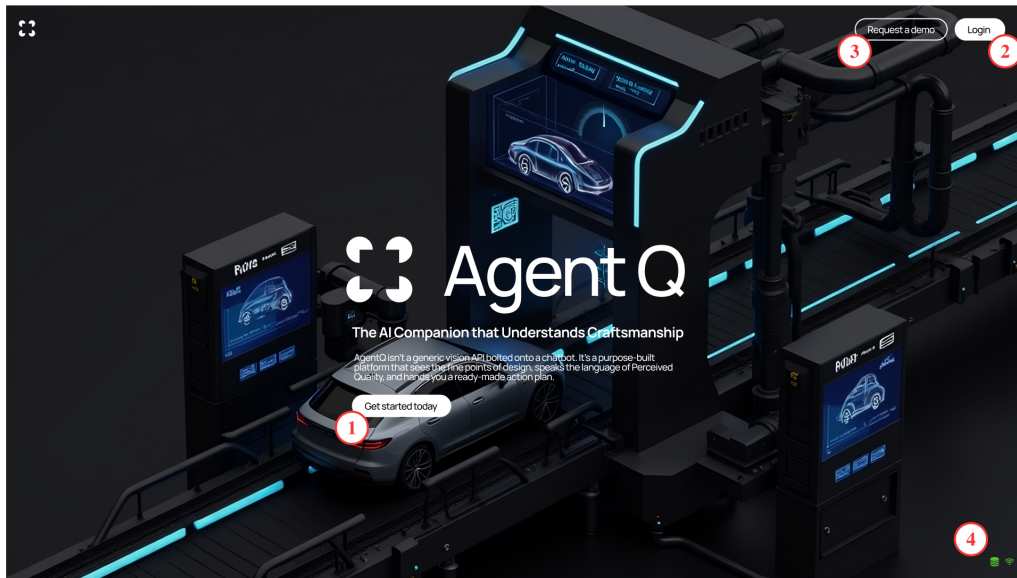


Figure 6.2: Start page of the AI agent prototype, presented to users upon entry.

Onboarding and Access

Upon landing on the Start Page, users are presented with straightforward options to proceed, such as to sign up ①, log in ② or request a demo ③. The interface follows established conventions for AI tools, using familiar UI elements for signing in, which lowers the barrier to first use (addressing Guideline 7 on aligning with users' mental models). A brief welcome message, "Hello, User!" greets the user once logged in, establishing a polite and professional tone. The Start Page also communicates information about data handling. In the interviews, automotive designers expressed significant concern about data privacy and intellectual property when using AI tools. Thus, a subtle but important element of the Start Page (and carried through the interface) is an emphasis on privacy and security. For example, an icon indicates that Agent Q runs on the company's secure network and servers ④, and that any uploaded data will remain safe. By providing this reassurance at login, the design addresses the need for clear communication of privacy (Guideline 3: Ensure data privacy and transparent communication). This helps build users' trust from the outset that adopting Agent Q will not compromise sensitive design data.

6.2.2 File Manager

After the Start Page, users access the File Manager interface (Figure 6.3), which serves as the organizational hub for projects and past AI interactions. Designed to feel immediately familiar to designers, the File Manager resembles a hybrid of a project dashboard and a file explorer. This design choice aligns with Guideline 7 (Align with users' mental models) by incorporating conventional files and folders with visual thumbnails, so users can apply existing knowledge of file management. The File Manager fulfills several critical user needs identified in the research. It provides a clear structure for storing and retrieving project data, supports both individual and collaborative work contexts, and offers easy access to engage with Agent Q's analysis capabilities.

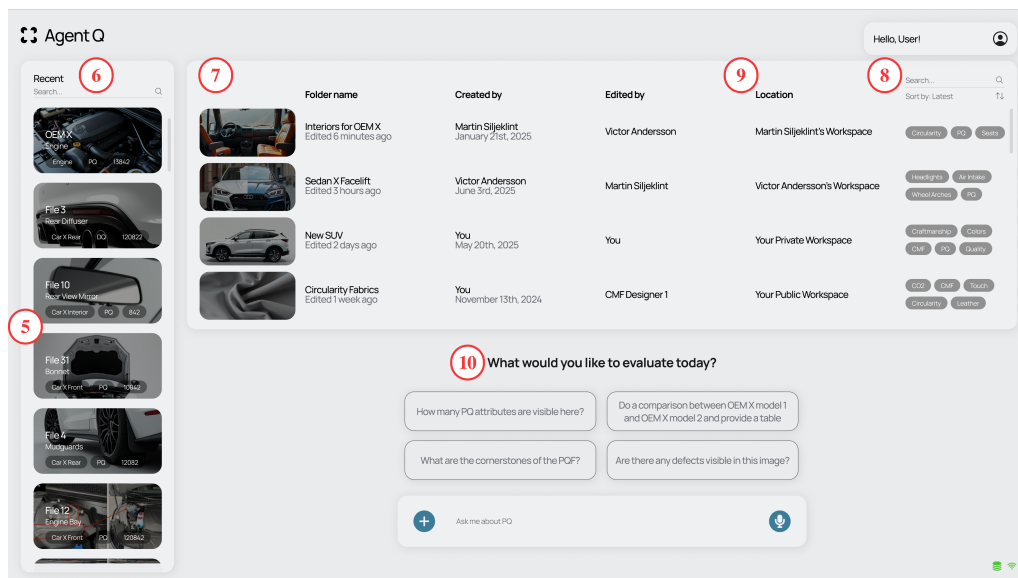


Figure 6.3: Interface of the File Manager, helping users to organize and manage projects within the AI agent.

Recent Files

The left panel of the File Manager (5) displays a list of the most recently interacted files. The files are represented with a thumbnail image accompanied by the file's name, description, and tags. To help with retrieval, a search bar is available at the top of the panel (6), allowing keyword searches from file names, tags, or even the content of past conversations. Participants in the study stressed the importance of quickly finding information from previous AI interactions. The search function addresses this and incorporates Guideline 5 (Promote Intuitive File Organization).

Project Organization

The main panel of the File Manager ⑦ displays a list of project files. Each file is represented by a thumbnail image and metadata such as the project or folder name, and attributes such as the last modified date, author, and storage location (see Figure 6.3). Users can customize sorting (by date, name, creator, etc.) or apply filters ⑧, implementing Guideline 5 by promoting intuitive file organization with flexible sorting and tagging. The structure was informed by recurring complaints about the difficulty of retrieving past AI conversations. Agent Q’s File Manager retains a persistent record of each file in a folder. For instance, when evaluating the “Rear Diffuser”, that analysis, including any chat conversations and outputs, is saved as a file. This layout helps users recall past conversations and results and integrates the AI’s outputs into the project-based organization they are already familiar with, thereby reducing cognitive load.

In the right column in the main panel of the File Manager is the location of the project or folder ⑨. Locations or workspaces are separated into private and shared domains. This design comes directly from interview insights that highlighted the duality of designers’ work modes, the need for a personal space for exploration, and a collaborative space for teams. In Agent Q, the private workspace contains projects and files that are visible only to the individual, allowing designers to experiment freely without fear of judgment. By providing a clearly defined private area, the tool supports this psychological need for a “safe” creative space. In contrast, the shared workspace enables collaborative evaluation and communication. Files placed here are accessible to colleagues or other stakeholders for review or co-creation. This implementation supports both individual and shared work modes within one system, addressing Guideline 2. Designers maintain control over what information stays private versus what is open for team collaboration by toggling between private and shared tabs, thereby addressing privacy control and Guideline 3.

Integrated Chat Box

At the bottom of the File Manager interface ⑩, Agent Q introduces AI querying with the question: “What would you like to evaluate today?” followed by a set of suggested prompts. When a suggested prompt is clicked or a custom query is submitted, the user is taken directly to the Chat Page (section 6.2.3) streamlining the workflow. Then, the user can choose to store the new conversation in an existing file or discard it.

The prompt suggestions exemplify co-creation. The system proactively contributes ideas, nudging the designer’s exploration without taking away control (Guideline 9). This was inspired by readily available chatbots (Guideline 7). By lowering the threshold for asking questions, the design encourages designers to utilize the AI’s analytical capabilities early and often.

6.2.3 Chat Page

On the Chat Page, users can interact with the AI assistant to evaluate designs and gather insights (see Figure 6.4). The interface resembles a traditional AI interface to align with the mental models of the users (Guideline 7), while improving the experience through several features. The page is designed to promote transparency, traceability, and the communication of data-informed insights in accordance with guidelines such as transparency (Guideline 1), flexible inputs (Guideline 4), and Enhance Decision-making with Objective Data (Guideline 6).

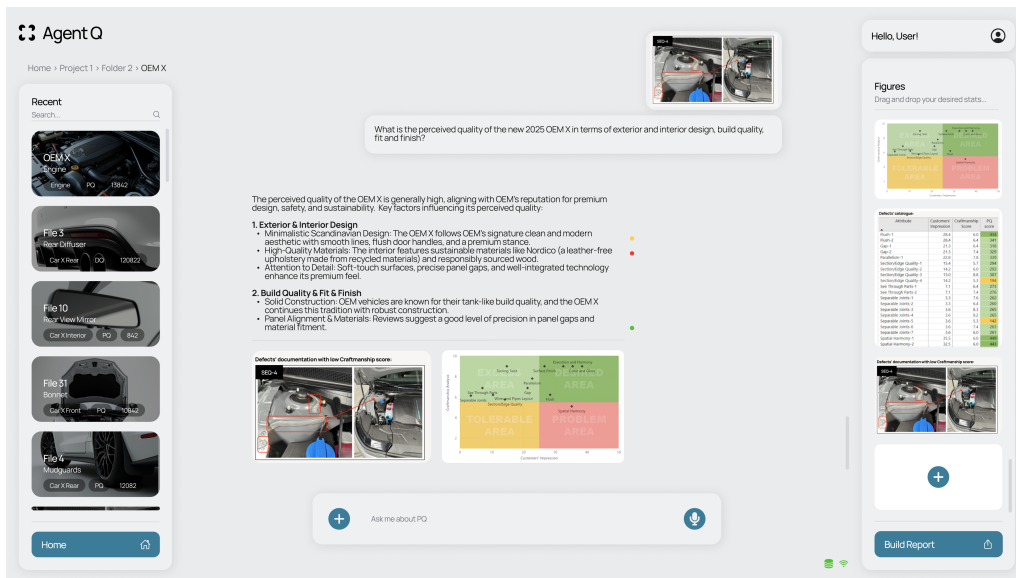


Figure 6.4: Expanded chat interface of the AI agent, displaying a detailed view of the conversation and available features.

Chatbox

The Chat Page features an input box (11) that supports interaction with Agent Q through text, voice, images, AR glasses, and various file types, or a combination of these (12), aligning with Guideline 4 on flexible input formats (see Figure 6.5). For example, this functionality enables users to submit text-based queries (e.g. “Compare the panel gap uniformity between these two models”) alongside visual references, such as images or other files. A button with a microphone icon transforms into

an arrow icon when the user starts recording audio or begins typing (13), indicating that the query is ready to be sent.

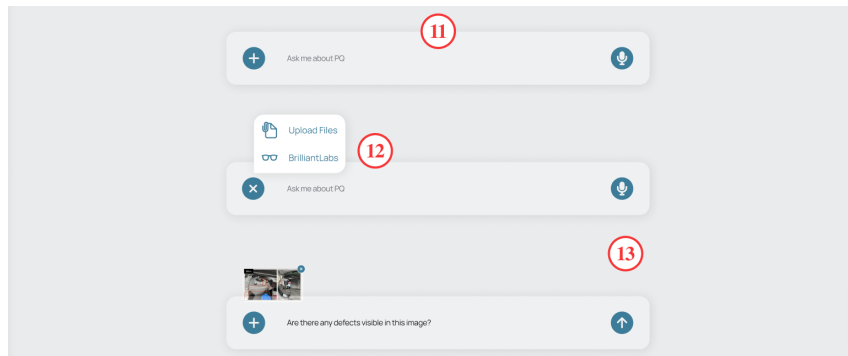


Figure 6.5: Close-up of the dynamic chatbox interaction when speaking, typing, or adding files.

Query Responses

Agent Q presents its responses within the chat stream (14), each answer containing text and, when relevant, accompanying visuals such as charts, tables, or annotated images. As seen in Figure 6.6, users can drag and drop visuals to a section on the right-hand side of the page (15) for easy export and to help users keep track of valuable insights. This feature supports a workflow in which designers can selectively curate the AI's output, addressing Guideline 9.

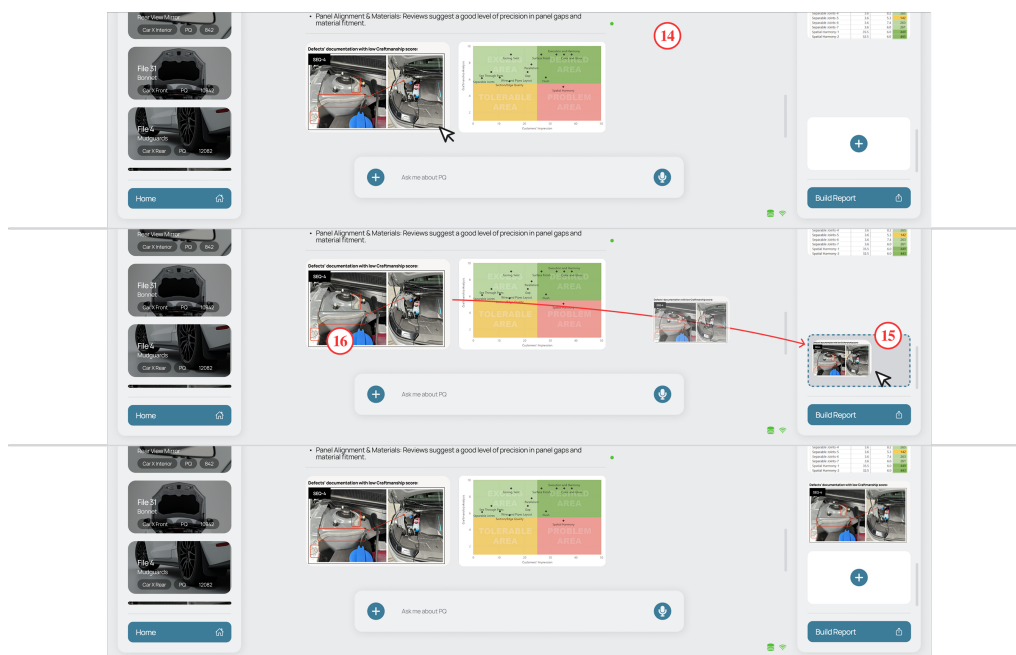


Figure 6.6: A sequence illustrating the drag-and-drop function between the query response and visuals section.

Findings, such as matrices or highlighted issues (16), use familiar visual cues (e.g., red/yellow/green), that align with users’ mental models (Guideline 7) and standardized accessibility practices (Guideline 8), facilitating intuitive interpretation. The responses also incorporate critical customer data from the Customer Acceptance Index to enhance decision-making (Guideline 6).

Transparency Features

To improve transparency and trust, the AI responses incorporate “transparency dots” (17), directly addressing concerns raised in interviews, and aligning with Guideline 1 (Ensure Transparency). The interactive dots appear alongside specific statements (see Figure 6.7). When clicked or hovered over, they reveal confidence levels (e.g., “Source: internal PQ dataset (2023), 1005 participants, confidence: 85%”) (18). This links each claim to verifiable evidence and indicates when a response is based on estimation. These features promote the perception of the AI as a helpful companion rather than an opaque system. They allow designers to examine, validate, and contextualize the AI’s outputs, thereby increasing confidence in the tool and supporting its integration into professional workflows.

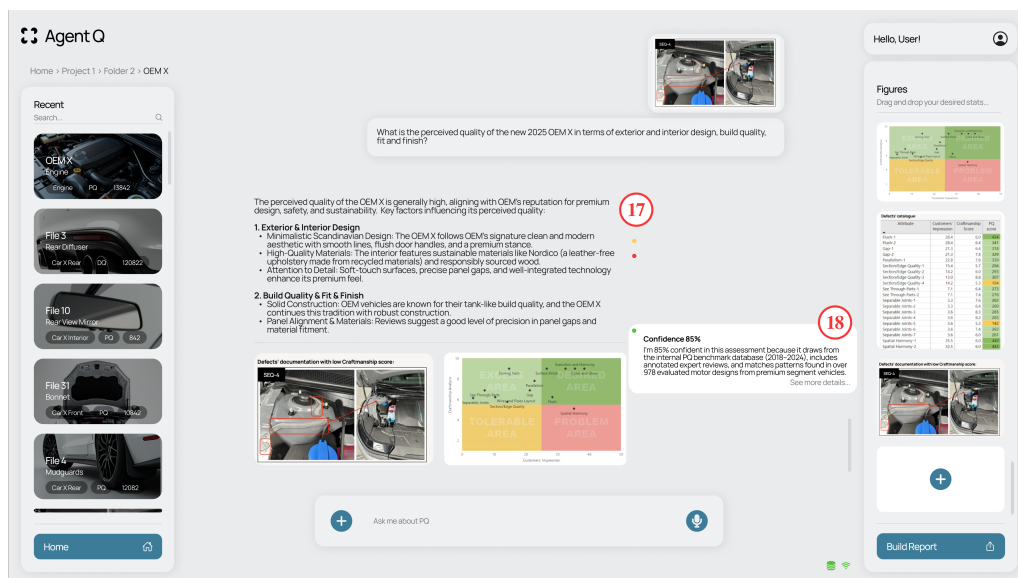


Figure 6.7: Highlight of the transparency dots, providing users with information about the AI agent’s reasoning and data sources.

6.2.4 Infinite Artboard

The Infinite Artboard is a unique feature of the prototype, providing a canvas for designers to collaborate and use AI-generated insights alongside their design materials (see Figure 6.8). Before, during, or after a chat session, a user can access the Artboard. The Artboard provides a non-conventional way of handling AI queries (addressing Guideline 5).

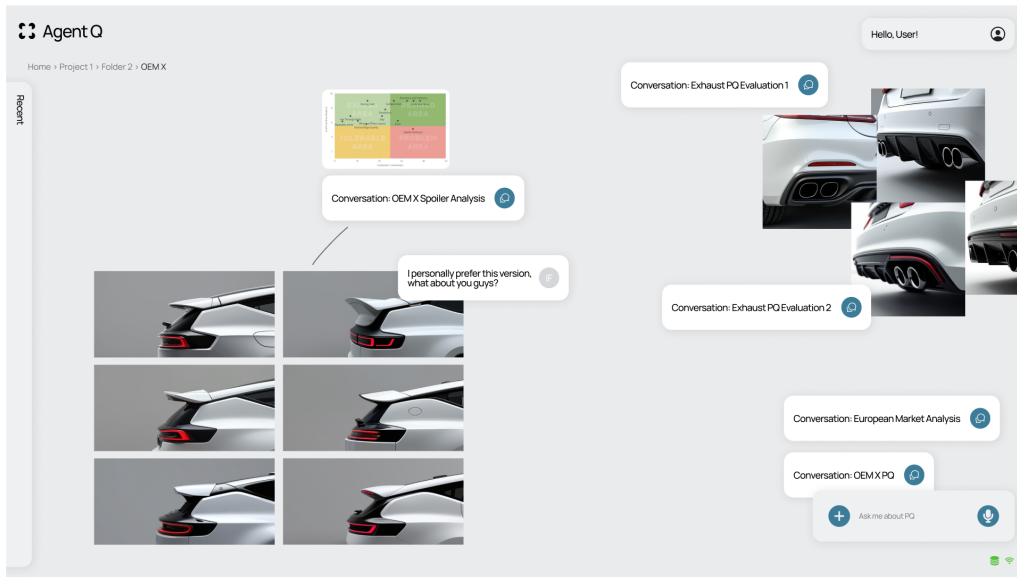


Figure 6.8: Overview of the infinite artboard feature, enabling users to spatially organize their findings in a non-linear way.

The Infinite Artboard is an expansive, zoomable canvas. Users can drag and drop elements such as images, text notes, and the AI’s responses onto the canvas (19) (see Figure 6.9). One of its core functions is to facilitate collaboration. Users can leave comments or annotations anywhere on the Artboard (20). If the Artboard is part of a shared workspace, team members can view each other’s comments and respond, effectively turning the Artboard into a live discussion board for design review sessions. It supports collaboration while still respecting privacy control (Guideline 2) since users choose which content to bring into the shared Artboard. The Artboard is dictated by the user, preserving the designer’s creative control (Guideline 9).

The Artboard also enables the embedding of AI evaluations. Users can place any output from Agent Q (e.g., charts, tables, annotated images, or text summaries) on the Artboard. By transparently showcasing the AI’s evaluations alongside designs, the Artboard helps teams discuss how the numbers and highlights correspond to their subjective experience of the design. This supports data-informed decision-making (Guideline 6).

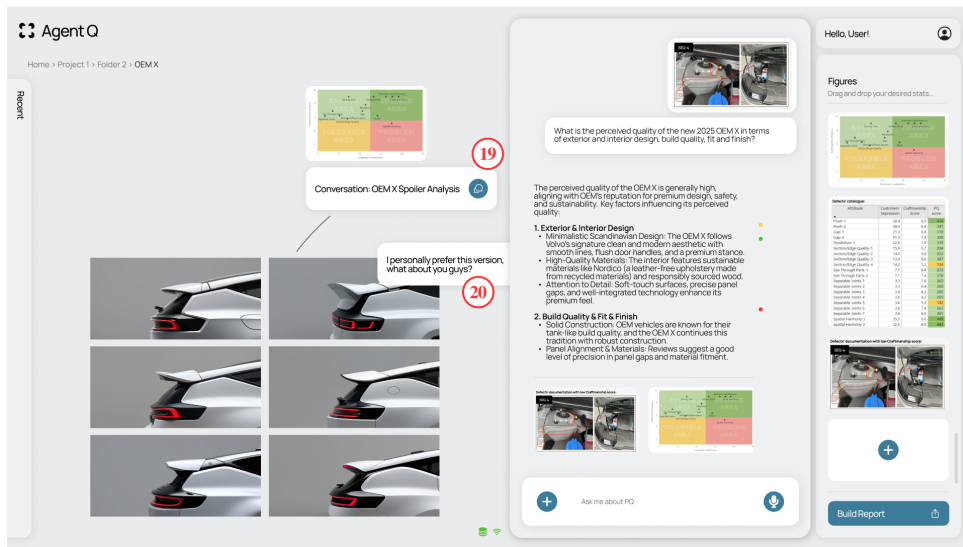


Figure 6.9: Integrated view of the infinite artboard and chat page.

6.2.5 Export Page

The final step in the Agent Q workflow is the Export Page. Here, the insights and figures compiled during the conversation can be reviewed and refined before being exported in formats suitable for sharing with stakeholders or embedding in existing project documentation. The Export Page (Figure 6.10) prepares reports, addressing the practical need for designers to communicate their findings in familiar formats, such as PDFs or PowerPoint slides. The Export Page directly reflects Guideline 4 by providing compatible outputs. It converts the content from the Artboard (section 6.2.4) or Chat (section 6.2.3) into a polished product ready for sharing. Throughout this process, the user maintains control over the final product, as per Guideline 9.

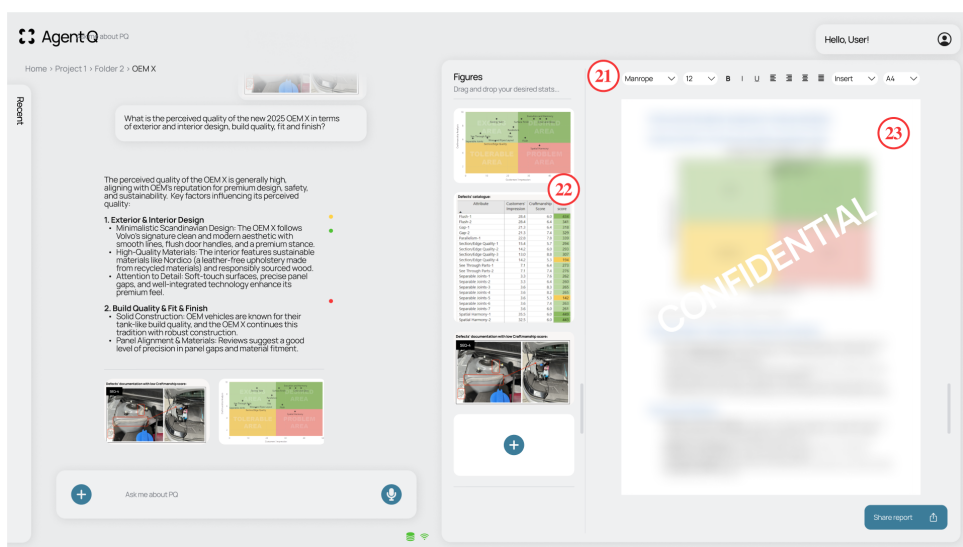


Figure 6.10: Export page interface to easily gather and share findings.

Report Compilation and Editing

The Export Page shows a simplified document editor (21). The interface typically shows a side-by-side view: on one side is a list of all available content pieces (22) (e.g., text summaries, figures, tables, and images) that can be included, and on the other side is a preview of the report or slide being created (23). The drag-and-drop function was also included to give designers control. For example, they might decide to include a bar chart comparing models but exclude a less important image, thus tailoring the output to the occasion. By letting users curate the content, the design ensures that the AI does not inadvertently share information that the designer deems irrelevant or sensitive. This aligns with Guidelines 3 and 9, which emphasize data privacy and user control.

The editing pane offers basic text editing, so that users can refine descriptions. This form of personalization allows the output to be adjusted to the designer's voice or the stakeholder's preferences, ensuring that the designer retains identity and authorship, in line with Guideline 9.

After arranging the content, the Export Page allows users to choose from multiple output formats (e.g., PDF, PowerPoint, or Excel file). This feature stems directly from Guideline 4, which emphasizes that AI tools should output to formats compatible with existing workflows. In practice, an automotive design team might need a PDF report for an internal quality review, while another scenario might call for slides to incorporate into a larger design presentation. The idea is that all exported files are formatted, for example, the PDF could include the company logo, the project name, and a summary of figures and captions. This anticipates that companies could customize these templates to reflect personalization at the organizational level.

The overall workflow aims to streamline tasks that traditionally take hours, such as copying results into PowerPoint or writing a report. As noted in the interviews, the participants valued spending less time on tedious tasks. The output of the analysis in ready-to-use formats allows users to focus more on interpreting the results and making design decisions.

7

Discussion

This chapter interprets the study’s findings in relation to the research questions, context, and existing literature. It highlights the significance of the results (section 7.1), reflects on the outcome (section 7.2), methodological choices and acknowledges limitations (section 7.3), ethics (section 7.4), and outlines Recommendations for Future Research and Development (section 7.5).

7.1 Key Findings

This section presents the main findings of the study, putting them into context and comparing them to literature. The main themes include the industry’s readiness for AI, personal barriers to adoption, the balance between subjective design and objective AI support, and the development of user-centered design guidelines.

The thesis answered the following research questions:

RQ: How can AI tools be designed in a user-centered way to support automotive professionals in their workflows and decision-making?

SQ1: What are the workflows and challenges experienced by designers, engineers, and decision-makers?

SQ2: How are AI tools currently applied within the automotive industry?

SQ3: What features and functions do automotive professionals require from AI tools, and how can interface design support these needs?

SQ4: What are the key barriers to the adoption of AI tools in the automotive industry, and how can they be addressed?

7.1.1 Industry Readiness for AI Adoption

The results of this study suggest that, at an industry level, the automotive sector demonstrates a strong readiness to adopt AI tools. This readiness is driven by a desire to increase efficiency and reduce costs, as well as to maintain a competitive edge by using the latest technology. Although all participants affirmed that the industry as a whole is prepared for AI integration, they also identified several barriers for themselves to adopt such tools, suggesting that most barriers exist on a personal level.

Addressing SQ2 and SQ4, the main barriers identified for AI adoption were reliability, privacy and data security, fear of replacement, and losing control. This suggests that trust is the overarching critical factor for successful AI adoption, which aligns with findings of Hancock et al. (2011) who state that trust is critical for effective interaction between humans and automated systems. For AI adoption in the automotive industry, these findings extend on existing research. While Reddy et al. (2024) identified key organizational inhibitors, such as lack of leadership commitment, poor interdepartmental coordination, and limited AI knowledge, the present study adds a complementary dimension by emphasizing human-centered concerns, reflecting a more individual and psychological form of resistance. This suggests that, beyond structural or strategic challenges, users' personal perceptions and emotional responses to new technologies must be taken into account when designing AI tools.

Another observation on readiness was the difference in attitude toward AI integration between younger and older designers. Younger participants tended to be more positive, viewing it as an opportunity to enhance their creative and analytical capabilities, whereas older participants were more cautious, more frequently emphasizing barriers. This may be attributed to generational differences in technological and AI adaptability, which would support existing literature (Stein et al., 2024). Alternatively, it could reflect years of professional experience, where more experienced professionals rely on established workflows and have a better understanding of what practices yield reliable results.

7.1.2 Creative Control and Identity

This theme relates to RQ, SQ1, SQ3 by highlighting how AI design must respect designers' workflows, identities, and their desire for control and authorship. Designers voiced concern that adopting AI could diminish their own role or creative authorship. Expressions of pride in their work and reluctance to accept external help

were recurring themes, highlighting that authorship, control, and creative identity remain important. This echoes the findings of Nielsen (2004), who emphasizes that a positive user experience comes from users feeling empowered rather than oppressed.

Design workflows have been optimized to meet designers' specific needs, and the study revealed concerns that AI tools might disrupt these established creative processes, or even replace aspects of the designers' role altogether. This subtle but persistent fear of replacement directly challenges adoption, regardless of the potential efficiency gains AI might offer, leading to requests for clear boundaries on the role of AI.

Participants largely agreed that AI should augment rather than replace the human designer, an approach consistently advocated in human-centered AI development. For instance, IBM AI Ethics Board (2023) has argued that AI should augment human intelligence, not replace it. Designers were more open to AI tools when they were presented as extensions of their capabilities without claiming authorship of the creative work. An AI tool must therefore position itself as an "assistant", offering inspiration, suggestions, and evaluation support without infringing on the creative authorship of the designer. In practice, this means developers should design the AI tools to leave the final decisions to the user. By positioning AI tools as supportive collaborators rather than autonomous creators, they are more likely to be seen as welcome additions rather than threats.

7.1.3 Privacy and Collaboration

In addition to general concerns about control, privacy emerged as a multifaceted concern with both technical and social dimensions, addressing RQ, SQ3, and SQ4. Designers expressed valuing private spaces for exploration. Simultaneously, the benefits of shared workspaces were acknowledged. This duality highlights the complex relationship designers have with their work, requiring both protected spaces and shared spaces. To account for this, AI tools must incorporate flexible privacy controls that allow users to selectively share or withhold their work. This design approach respects the integrity of the creative process while still enabling the collaborative benefits that participants identified as valuable.

Beyond creative privacy concerns, automotive designers were wary of how AI tools would use and store their design data. This demonstrates that, beyond interface design considerations, AI tools must address data handling transparently. Participants consistently wanted explicit reassurance about data security, particularly given the

highly competitive nature of automotive design. Clear communication about how data is stored, processed, and protected will be essential for adoption. This aligns with prior research underscoring the role of explainability and transparency in building trust in AI systems (Bedué and Fritzsche, 2021; von Eschenbach, 2021).

7.1.4 Balancing Subjectivity and Objectivity in Design Evaluation

A noteworthy insight concerns the tension between the inherently subjective nature of design evaluation and the growing demand for more objective, data-informed support, informing RQ, SQ1, SQ2, and SQ3. While designers acknowledged the importance of intuition, experience, and personal judgment in their creative processes, they also expressed a clear interest in AI systems that could provide complementary, evidence-based insights. This duality reinforces prior research highlighting the value of balancing subjective and objective intent in other creative domains (Hassenzahl, 2004; Sharp et al., 2019).

Participants specifically noted the value of having measurable, transparent criteria to support decision-making, particularly in contexts where aesthetic and functional considerations intersect. The numerical data or objective assessments were also seen as valuable tools for strengthening arguments to management, providing designers with greater leverage to justify their choices. The appeal of AI tools was strongest when their outputs were interpretable, clearly sourced, and did not undermine creative autonomy.

Together, these insights suggest that effective AI integration in design must support a hybrid model of evaluation, one that leverages objective feedback without diminishing the designer’s ego.

7.1.5 Practical and Theoretical Implications of Design Guidelines

One notable outcome of the project was the development of user-centered design guidelines for AI agents in the automotive industry, addressing RQ based on insights from SQ1–SQ4. These guidelines offer concrete strategies for designing AI tools that align with the needs and expectations of professional users in the sector. If implemented, they have the potential to improve the usability of AI tools, create user trust, and support long-term engagement, thereby supporting the integration and adoption of AI into existing design workflows.

On a theoretical level, the findings contribute to the growing body of knowledge on user-centered AI design. While the guidelines were developed solely from the thematic analysis, they reinforced the value of existing, but very limited, guidelines for designing AI agents, such as those outlined by Weisz et al. (2023). The authors propose six design principles for AI applications: (1) *Design for Multiple Outputs*, reflected in Guideline 4: Provide Flexible Inputs and Compatible Outputs; (2) *Design for Imperfection*, resonating with Guideline 1: Ensure Transparency; (3) *Design for Human Control*, which aligns with Guideline 9: Nurture the Designer’s Ego; (4) *Design for Exploration*; (5) *Design for Mental Models*, which directly connects to Guideline 7: Align Usability with User’s Mental Models; (6) *Design for Explanations*, closely aligned with Guideline 3: Ensure Data Privacy and Transparent Communication. There were also similarities with the later study by Weisz et al. (2024), which is referenced in section 3.1.

At the same time, this research extends previous work by offering more specific and context-driven recommendations, grounded in the needs of automotive designers. To date, there has been little research focused on developing AI agents specifically for the automotive industry or for design practitioners more broadly. By bridging this gap, the study lays the groundwork for the future development of AI tools that are better aligned with the workflows, challenges, and needs of creative professionals in industrial settings.

7.2 Reflection on Outcome

While the initial brief and the project’s early stages put a large emphasis on interaction design and interface considerations, the client’s evolving needs and insights from qualitative data collection revealed that articulating transferable knowledge for future AI agent development would be more valuable.

This shift, from delivering an interface to producing generalizable, data-informed design guidelines, is evident in the number of topics presented related to interface design, such as Usability (subsection 3.3.1), User Experience (subsection 3.3.2), and Accessibility (subsection 3.3.3). While these theories provided a solid foundation for the interface prototype presented later in the thesis, their prominence may not be entirely proportional to theories that ultimately proved more central, such as Design Principles for AI Agents (section 3.1) and Barriers to AI Adoption (section 3.2).

In practice, the interface prototype served several roles. It served as a tool for grounding and testing the emerging design guidelines while also engaging stake-

holders. It also became an outlet for creativity, further emphasizing our education as designers. Thus, rather than being a final deliverable, the interface prototype evolved into a medium through which we could apply our proposed guidelines in practice.

The guidelines emerged as the project's primary contribution, both academically and in terms of practical utility. Nevertheless, the inclusion of an interface concept, albeit at a lower fidelity than originally planned, added credibility and relevance.

A key strength of this project lies in its ability to adapt and reframe its goals in response to changing conditions while still producing valuable outcomes. Initial project scopes often shift in response to emerging insights and stakeholder needs, and this project has been no exception.

7.3 Reflection on Methodology and Limitations

Several limitations should be acknowledged that may have impacted on the generalizability of the findings. First, the sampling strategy, while targeted and intentional, resulted in a relatively small participant pool consisting of 12 individuals. Although this number is not uncommon in qualitative design research, it limits the broadness of perspectives captured.

Furthermore, the sample consisted of professionals with extensive industry experience, particularly in Color, Materials, and Finish (CMF) and Design Quality roles. While these areas are highly relevant to the intended application of the AI agent, they do not fully represent the range of stakeholders involved in automotive design. Additionally, the geographic concentration of participants in Sweden and France restricts the cultural and organizational diversity of responses, potentially limiting the applicability of insights to a broader international context.

Second, the data analysis process was based on thematic analysis within a grounded theory framework. Efforts were made to validate coding through iterative workshops, but the interpretative nature of qualitative coding means that complete objectivity cannot be guaranteed.

Moreover, the study was conducted in collaboration with a company that had a clear objective: to develop a data-informed AI agent for perceived quality evaluation. This context influenced the formulation of interview questions and could potentially have unconsciously affected thematic focus. Although this alignment strengthened

the study's relevance to real-world applications, it may also have introduced confirmation bias, directing attention toward themes, such as designer subjectivity and data-informed insights.

Lastly, while the study resulted in a set of design guidelines and an interface prototype, the lack of formal usability testing constitutes a significant limitation. User testing was an intended part of the project from the outset; however, delays from stakeholders in delivering a functional AI agent prevented the evaluation of a fully operational system. Given that the agent's core functionality would play a critical role in shaping the user experience, we chose not to proceed with usability testing in the absence of a working AI agent. Consequently, while the guidelines are grounded in extensive qualitative analysis, their effectiveness in real-world design contexts remains unverified.

7.4 Ethics of Study Implications

The development of AI tools for automotive design carries broader societal implications. One key concern is the potential impact on professional roles and job structures. If AI tools begin to automate evaluative or creative tasks, there is a risk of diminishing human expertise and displacing designers' contributions. By emphasizing AI as a supportive collaborator, the guidelines created in this thesis aimed to emphasize the importance of not replacing the designer but augmenting.

Another ethical consideration is fairness and inclusivity. AI systems trained on narrow datasets may reinforce stylistic biases or exclude diverse user needs. To support responsible innovation, such tools should promote transparency, be explainable, and reflect a wide range of design perspectives.

Finally, as AI accelerates design workflows, it is essential to remain mindful of its environmental footprint. Ethical deployment should not only aim for efficiency but also encourage sustainable and thoughtful design choices.

In conclusion, technological advancement should be accompanied by social and environmental responsibility.

7.5 Recommendations for Future Research and Development

This thesis project serves as an initial step in developing design guidelines for AI tools in the automotive industry. While the proposed recommendations are grounded in user-centered research, further work is required to refine and expand them.

7.5.1 Future Research

In this thesis, a user-centered design approach was applied to gather insights for developing an AI agent focusing on Perceived Quality in automotive design. However, the underlying methodology and insights gathered are not limited to PQ alone. The inclusion of participants from the Color, Materials, and Finish (CMF) domain indicates that the proposed guidelines may have broader applicability across other design domains. A promising direction for future research is to test these guidelines in additional application areas within the automotive industry. A part of this work could also contain a deeper exploration of the similarities and differences of existing guidelines with the ones developed in this thesis.

Moreover, by applying the insights from this study in industries beyond the automotive context, it would further test the generalizability of the findings. Doing so would help determine whether similar user needs, interaction patterns, and barriers to adoption exist across sectors.

Finally, the proposed guidelines and prototype require validation. Future work should include structured user testing with design professionals to evaluate usability, impact on workflow, and adoption potential. This would provide critical feedback for refining the agent and verifying the effectiveness of the design recommendations in practice.

7.5.2 Future Development

A critical next step involves the iterative development and evaluation of the proposed design concept. While the current prototype demonstrates how the guidelines might be applied, it remains a theoretical construct and has not yet been tested with its intended user group. Usability testing with actual automotive designers is therefore, essential to assess effectiveness, acceptance, and overall user experience.

In its current form, the prototype remains limited in its functionality. While it demonstrates the conceptual application of AI in PQ evaluation, it is not fully operational in terms of its technical capabilities. Full implementation would require additional resources, such as coding expertise and infrastructure to support data processing.

To move from concept to deployment, it will be necessary to collaborate with development teams working on the backend infrastructure. This includes setting up an API, integrating the interface with backend components, and deploying the system in an environment where it can be tested. Such integration would allow the interface to be evaluated not only as a design prototype but as a fully functioning system, providing a more comprehensive understanding of its real-world performance.

Ultimately, through iterative refinement and technical integration, the aim is to enhance the usability, accessibility, and effectiveness of AI tools in design workflows. By validating the guidelines through practice and aligning the interface with the needs of real users, future work can contribute to the development of AI systems that are both technically robust and meaningfully embedded in the work of automotive designers.

8

Conclusion

This thesis investigated how to design user-centered AI agents for the automotive industry, with a specific focus on evaluating and supporting Perceived Quality (PQ) assessments. Through interviews with designers, engineers, and decision-makers, a thematic analysis was conducted to understand current workflows, identify pain points and needs, and explore attitudes toward AI integration. The findings resulted in a set of design guidelines and a high-fidelity prototype aimed at supporting designers in their evaluative tasks while maintaining creative control and identity.

The study found that while the automotive industry is ready for AI adoption, individual barriers remain significant. Concerns about loss of control, transparency, trust, and compatibility with existing workflows were prominent. Participants emphasized that AI should act as a supportive partner rather than a replacement, providing transparent and intuitive, data-informed insights without undermining the designer's ego. These needs informed the proposed guidelines, which address both functional and psychological aspects. A summary of the guidelines is presented below, with further details available in section 6.1.

While the prototype offers a concrete application of these guidelines, its current form is conceptual and requires further development and testing. However, the user-centered approach adopted in this research demonstrates the value of involving users early in the AI design process to ensure alignment with existing practices and expectations.

This work contributes to the growing research on human-centered AI design in industrial contexts by highlighting the subjective, emotional, and contextual dimensions of adoption. By capturing both functional requirements and psychological concerns, it provides a nuanced foundation for designing AI tools that are not only effective but also adopted by their users. Future research should build on these insights through validating the proposed guidelines, extending user testing, and developing to move from concept to viable implementation.

Guidelines

Guideline 1. Ensure Transparency: AI agents must clearly communicate the reliability, validity, and data sources of their insights. This transparency is essential for building trust and encouraging adoption.

Guideline 2. Support Both Individual and Shared Workspaces: AI agents should accommodate both private and shared workspaces, encouraging individual creativity while improving communication and handovers in collaborative settings.

Guideline 3. Ensure Data Privacy and Transparent Communication: Beyond protecting sensitive data and offering local processing, AI agents must transparently communicate potential risks and non-risks to build user trust.

Guideline 4. Provide Flexible Inputs and Compatible Outputs: AI agents should support multiple input types (particularly text but also e.g., voice and visuals) and provide outputs in formats compatible with users' workflows (e.g., slides, PDFs, tables) to aid collaboration and sharing.

Guideline 5. Promote Intuitive File Organization: Interfaces should allow for organization with custom naming, tags, thumbnails, and filters. This supports memory recall, project management, and reduces cognitive load.

Guideline 6. Enhance Decision-making with Objective Data: AI agents should present insights backed by objective data and standardized frameworks to support decision-making.

Guideline 7. Align Usability with Users' Mental Models: Usability must align with users' workflows and mental models through intuitive UI design, visual clarity, and respect for existing tool habits to ensure smooth integration.

Guideline 8. Follow Accessibility Practices: Interfaces should follow established accessibility standards (e.g., WCAG 2.1) to serve a diverse range of users, including those with varying abilities and needs.

Guideline 9. Nurture the Designer's Ego: AI agents must act as creative partners, not replacements, supporting co-creation while ensuring that final decisions remain with the human designer to preserve authorship and identity.

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A

Interview Guide

Background

This document outlines the guidelines to follow for conducting interviews with Project partners. It sets out the interview content and the guidelines we will follow to give anonymity of the data presented in the final report.

Project Description(s)

General Design Assistant AI One Pager

The Project

The Design Quality AI project aims to transform vehicle design by integrating Artificial Intelligence with customer insights in Design Quality (DQ) evaluation. To meet evolving consumer expectations and industry demands, automakers need advanced tools to stay ahead. This project focuses on the development of a customer insight-driven NextGen AI agent to assist designers, engineers, and decision-makers in evaluating and optimizing DQ.

Traditional DQ assessment methods rely on subjective judgments and inconsistent data collection, leading to inefficiencies in decision-making. This AI-powered solution integrates customer insights and advanced machine learning to provide real-time, actionable feedback, ensuring that design decisions align with user expectations and industry standards. It aims to improve the efficiency and accuracy of DQ assessments, reduce time-to-market for new designs, and improve designs.

By collaborating with graduate students from Industrial Design Engineering, Computer Science and Engineering, and Automation and Mechatronics, this 5-month

multidisciplinary project aims to develop the backbone of the AI agent by performing machine learning with design quality metrics and customer feedback and by investigating how the user will interact with it.

The Study

This particular study aims to conduct user research in the development of the AI agent, ensuring its integration into existing automotive design workflows, with features and interfaces based on the needs and wants of the intended users, as well as anticipating possible barriers to the adoption of the technology.

CMF Circularity AI One Pager

The CMF Circularity AI project aims to transform vehicle design by integrating sustainable materials with customer insights on Color, Material, and Finish CMF. The automotive industry faces growing pressure to adopt environmentally friendly materials while maintaining premium quality and customer satisfaction. Traditional materials like leather and hard plastics contribute to environmental harm, while eco-friendly alternatives often lack consumer acceptance. This project leverages AI-driven generative design and customer perception analysis to address these challenges and align material choices with sustainability and market expectations.

The project is structured around four key objectives: reducing vehicle production's carbon footprint by 25% through sustainable material selection, ensuring 90% of customers perceive these materials as equal to or superior to traditional options, cutting the time-to-market for new materials by 30%, and supporting circular economy practices by incorporating 50% recyclable or renewable materials in production. These goals aim to strike a balance between environmental impact reduction and delivering high perceived quality.

Through a 12-month pre-study, the project will develop an AI model capable of optimizing material selection by integrating circularity metrics and customer feedback. Work packages will define sustainability criteria, gather insights on customer perceptions, integrate this data into an AI-driven framework, and create a roadmap for implementation. The project expects to establish a scalable model for sustainable CMF design, fostering innovation and collaboration across the automotive sector while addressing customer concerns about eco-friendly materials' aesthetic and functional quality.

By aligning with the FFI Circularity program, the project supports climate-neutral manufacturing, circular economy principles, and fossil-free transport. It advances sustainable automotive design and aims to set new industry standards, amplifying the role of AI in optimizing material selection and enhancing customer satisfaction.

Interview Scripts

The interviews will be broken into two halves: Design Quality and CMF Circularity. These interviews may be conducted with the same interviewees or split based on the expertise of the interviewees. The interviews will be semi-structured and follow the flow below.

Introduction

- Thank you for taking the time to meet with us.
- We are collaborating with several companies such as Intended Future, a company specializing in Design Quality assessment for the automotive industry, and Vinnova- a public research body.
- Our goal is to explore challenges in design evaluation and material circularity within CMF design, As well as how AI-driven tools could improve the design process.
- Any future AI tool aims to provide data-informed insights for design decisions by analyzing extensive datasets, including customer feedback from various regions and sustainability data about materials.

Consent & Recording

- Before we begin, we kindly ask for your consent to record this session for research purposes. We are working according to GDPR. The recording will only be used for analysis and will not be shared externally. Is that okay with you?
- Fill out a consent form.
- Do you have any questions before we begin?

Background & Current Work Context (Shared)

1. Could you briefly describe your background and role as a designer?
 - (a) How long have you been working with automotive projects, and how has your role evolved?
 - (b) What types of projects do you typically work on?
 - (c) How does your role relate to design quality, styling, or decision-making? What kind of influence do you have (if any)?

Understanding Design Processes (Shared)

2. Could you describe the typical design process you go through on a project?
3. What are the key challenges you face in your design process?
 - (a) Are there specific tasks or processes that feel inefficient?
 - (b) What are the biggest challenges in achieving high-quality design outcomes?
4. How do you currently validate design choices across different vehicle elements?
5. How and where in the design and development process do you measure how good a design is? Who/what is the arbiter of a good design outcome?
 - (a) Are you using any specific tools?
 - (b) Do you feel there is a gap in the current tools and methods available?
6. Which factors are most critical in making design decisions (e.g., aesthetics, functionality, brand identity)?
7. Who are the main stakeholders involved in design-related decision-making?
8. How do you ensure that consumer feedback and expectations are considered?
 - (a) What role does customer perception and feedback play in the automotive design process?

Design Assistant Assessment (General Design Assistant /PQI Agent Only)

9. Tell me a bit about the AI tools you are aware of. Which ones do you use, and which ones do you want to try out?
 - (a) What are the biggest benefits and challenges of using AI-driven tools from your experience?
 - (b) When in the design process do you currently use AI-powered tools?
10. If a Design Assistant were available, what tasks would you want/need/expect it to assist with?
 - (a) What kind of information would you like to get from an AI-supported design assistant?
 - (b) How would you validate AI-generated design insights against traditional methods?
 - (c) What UI would you expect? And are there any tools you use today within design that you find enjoyable and intuitive?
 - (d) Things for them to consider:
 - i. How would you like your files to be sorted? Workspace: Infinite artboard (think Figma) or chatbot style (ChatGPT)?
 - ii. What file formats and layout would be good Voice/text/live video-based (glasses)
 - iii. Would you use a sketch-in tool?
11. Which features would you need to improve collaboration between designers, engineers, and decision-makers when using a Design Assistant?
 - (a) Would you see this as a collaborative, shared space, or individual-centered experience?
12. How ready do you feel the automotive industry is to adopt AI-driven solutions for design?
 - (a) What barriers do you foresee in the industry's adoption of such technology

13. Would you trust AI-generated design recommendations? If not, what would be required to build that trust?

CMF and Circularity (CMF only)

1. How do you choose and validate materials, colors, and finishes in your design process?
 - (a) What are the most significant challenges in CMF decision-making?
 - (b) How does circularity factor into your CMF choices?
 - (c) What circularity strategies are integrated into the CMF design process?
 - (d) Are there any circularity targets set for the CMF process? If yes: What are the targets?
 - (e) What indicators are being used to measure how the targets are met?
 - (f) How do you follow up on the targets?
 - (g) What is the connection between CMF circularity targets and the company's overall sustainability and circularity target?
2. What barriers do you face when trying to design with circularity in mind?
 - (a) How do you assess the environmental impact of different CMF choices? -what impact areas do you focus on? Are there any legal requirements or standards that you work to?
 - (b) What tools or data sources do you currently use to evaluate CMF sustainability and circularity? Do you conduct LCAs? Search online?
 - (c) How do you ensure that consumer feedback and expectations are considered when making material choices?
 - (d) What information do you feel you lack when making decisions?
3. Which factors are most critical in making design decisions (e.g., aesthetics, functionality, brand identity, circularity/ sustainability)?
4. How do you follow CMF trends in the automotive industry? What/ who are the tastemakers?

- (a) How safe do you feel making bold design decisions? What are you afraid of?
- 5. Who are the main stakeholders involved in design-related decision-making and how do they consider circularity in decisions?

AI Integration & Potential Impact (CMF only)

- 6. Tell me a bit about the tools you are aware of. Which ones do you use, and which ones do you want to try out?
 - (a) Which AI tools are you aware of? Do you currently use any tools involving AI? If so, where in the design process do you use them?
 - (b) What are the biggest benefits and challenges of using AI-driven tools from your experience?
- 7. If a CMF Design Assistant were available, what tasks would you want/need/-expect it to assist with?
 - (a) What kind of information would you like to get from an AI-supported design assistant?
 - (b) How would you validate AI-generated design insights against traditional methods?
 - (c) How would you expect an AI tool for your work to look and behave? And are there any tools you use today within design that you find enjoyable and intuitive?
 - (d) Things for them to consider:
 - i. What kind of UI/ Interface?
 - ii. How would you like your files to be sorted? Workspace: Infinite artboard or chatbot style? What file formats and layout would be good
 - iii. How would you provide input to an AI tool? Would you like ask questions? Send pictures? Sketch in etc.
 - iv. What content would you expect to get from a CMF or circularity focused AI tool? What metrics are important to help you and others make decisions?

- v. Which features would you need to improve collaboration between designers, engineers, and decision-makers when using a CMF Design Assistant?
- vi. Would you see this as a collaborative, shared space, or individual-centered experience?

Future Expectations and Objections (CMF only)

- 8. How ready do you feel the automotive industry is to adopt AI-driven solutions for design?
 - (a) What barriers do you foresee in the industry's adoption of such technology
- 9. Would you trust AI-generated design recommendations? If not, what would be required to build that trust?
- 10. If an AI Agent could support CMF design, what functionalities would be most useful?
 - (a) How could AI improve material selection or circularity assessments?
 - (b) Would AI-powered trend analysis be valuable for your CMF work?

Data Handling Guidelines

Below is a description of the guidelines we will follow in the handling and use of data gathered from the interviews.

GDPR and Data Handling

We will follow the GDPR directive as set out by the European Commission:

“GDPR is an EU law with mandatory rules for how organizations and companies must use personal data in an integrity friendly way. Personal data means any information which, directly or indirectly, could identify a living person. Name, phone number, and address are schoolbook examples of personal data. Interests, information about past purchases, health, and online behavior is also considered personal data as it could identify a person.” - gdprsummary.com, 10 March, 2025

The data collected from interviews to final report will follow this flow:

1. Interviews conducted either in person or online, recorded using digital recording tools, (Dictaphone, Call recording, and so on).
2. Transcripts will be produced from this collected digital recording using voice-to-text AI tools such as aTrain. (aTrain is an offline text-to-voice AI tool developed in Europe for use by universities.)
3. The transcripts will be scrubbed of interviewee names and company names. “John Smith” becomes “Interviewee 1”, and “Saab” becomes “Automotive Company A” for example.
4. After the transcripts have been transcribed and scrubbed of personal data, the original recordings and transcripts will be deleted.

Transcript review and redaction

After the interviews have been digitally recorded, participants and companies have the right to request redactions from the interviews for up to one week post-interview date.

Consent for Participation in Research

I volunteer to participate in research conducted by Intended Future, Chalmers University of Technology, Chalmers Industriteknik, Boid AB, and partners

Participants agree to:

1. My participation is voluntary, and I understand that I will not be paid for it. I am aware that I have a right to withdraw and discontinue my participation at any time during the interview.
2. I understand that participation involves being interviewed by researchers, and during the interview the required data will be recorded.
3. I have been assured that my identity and the information obtained from this interview will not be disclosed, and that my confidentiality as a participant in this study will remain secure and anonymous.
4. Subsequent uses of records and data will be the subject of standard data use policies which protect the anonymity of individuals and institutions. However, the access to the above-mentioned information is strictly open to only the researchers involved.
5. I understand that this is a research study and for further queries I'm allowed to contact the organizations performing research
6. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study. I have been given a copy of this consent form.

Participant Name:	Signature of Witness:
Participant Signature and Date:	Signature of the Investigator:

B

Thematic Analysis

Theme & Code	Mentions
Adoption and Use of AI Tools in Design	53
AI for inspiration and ideation	19
AI for research and information	16
AI for research and information (duplicate?)	3
inexperience	8
visualization	7
Background and Experience	24
CMF	4
design engineering	2
design quality	5
industrial design engineering	4
interaction design	3
mechanical engineering	3
strategy	1
sustainability	2
Challenges in the Design Process	121
communication	10
costs	17
data collection	1
data organization	3
evaluation	12

Continued on next page

B. Thematic Analysis

Theme & Code	Mentions
idea fixation	3
inefficiencies	9
limitations	15
limited knowledge	22
prioritization	1
reaching out to users	14
time	9
uncertainty in decision-making	5
Design Process Workflow	52
briefing	2
concept refinement	7
ideation	9
iterative evaluation	6
prototyping	9
research	15
user studies	4
Design Quality and Decision-Making	105
aesthetics vs. functionality	2
aesthetics vs. functionality	12
branding	1
decision maker	39
designer subjectivity	14
external stakeholder demands	2
functionality	10
market	8
measurable quality	5
sustainability	12
Desired Features and Collaborative Environments	192
collaborative vs. individual spaces	27
concept evaluation	10
data-informed insights	19

Continued on next page

Theme & Code	Mentions
file organization	19
graphics output	10
input	28
interface	12
other features	39
traits	10
transparency	18
Industry Readiness and Barriers to AI Adoption in Design	85
control	15
domain-specific limitations	9
fear of replacement	10
industry acceptance	31
privacy concerns	20
Trust, Reliability, and Limitations of AI Tools	49
accuracy concerns	18
limitations in creativity	6
limitations in human interpretation	7
overconfidence	2
validating AI insights	16
Validation and Evaluation Techniques	63
measurable success criteria	12
observational evaluation	13
tools	9
user evaluation	29

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