



# AI Alchemy

Exploring opportunities for generative AI in new product development

— — — — — François Prévot  
— — — — — Master Thesis  
— — — — — Strategic Product Design  
— — — — — Delft University of Technology

*May 1<sup>st</sup>, 2025*



### **Supervisory Team**

Dr. P.A. (Peter) Lloyd — *Chair*

Dr. R.S.K. (Senthil) Chandrasegaran — *Mentor*

### **Delft University of Technology**

Faculty of Industrial Design Engineering

— — — — —

### **Company Team**

O. (Ozlem) Mandira — *Mentor*

A. (Aernout) Dijkstra-Hellinga — *Supervisor*

### **Bugaboo International B.V.**

— — — — —

### **Copyright**

© 2025 F.P.E. (François) Prévot

## Foreword

I dedicate this thesis to my parents, whose sacrifices made my opportunities in The Netherlands possible. I am deeply grateful to them.

The seed of this thesis was planted in 2022 during the Design Theory and Methodology course taught by Senthil Chandrasegaran and Peter Lloyd. During that course, I wrote *Dancing with AI: The Designer Arbiter Role in Design Concept Generation* and *Zeno's Endless Race: On the Paradox of AI Replacing Human Designers*. Early experiments with OpenAI's GPT-3 playground interface (pre-ChatGPT) sparked my fascination with generative AI and its impact on design. Through this, I also got to know Peter and Senthil as inspiring, multidisciplinary teachers and kind, genuine mentors. In 2024, they introduced me to Ozlem Mandira and Aernout Dijkstra-Hellinga to start this graduation project.

These early experiences laid the foundation for everything that followed. I am deeply grateful to Senthil and Ozlem for their mentorship, and to Peter Lloyd and Aernout for their supervision and generous support. I thank Arthur Collins, Kaj Geheniau, and my father for proofreading the manuscript and offering valuable feedback. I also thank the Bugaboo team for welcoming me and embracing the spirit of experimentation that shaped this work.

Special thanks go to Sergej Schetselaar, Tom Kortenbach, and Arthur Collins, who profoundly influenced my six years at the faculty. Finally, my heartfelt thanks to my friends, family, and loved ones for their unwavering support throughout this journey.

- François E



*The history of science is rich in the example of the fruitfulness of bringing two sets of techniques, two sets of ideas, developed in separate contexts for the pursuit of new truth, into touch with one another.*

*— J. Robert Oppenheimer, 1953*

## AI Alchemy in one page

This thesis examines the integration of generative artificial intelligence (AI) into industrial design practice, using Bugaboo's new product development as a case study. It explores the opportunities for generative AI to augment new product development, how these opportunities can be scaled, and the insights gained from its practical application in real-world design processes. Grounded in theories such as bounded rationality and expandable rationality, the work introduces the Frame–Propose–Evaluate (FPE) simplified model of design, structuring design into iterative cycles of framing, proposing, and evaluating, each supported by uncertainty-driven actions: information, representation, and reflective action.

Emerging evidence suggests that generative AI can accelerate product development by expanding the problem–solution space and compressing iteration cycles. However, it also raises concerns about increasing design fixation, limiting originality, and blurring human–AI collaboration. Its application in live, design-led organizations remains largely unexplored, offering new opportunities to study integration into uncertainty-driven workflows.

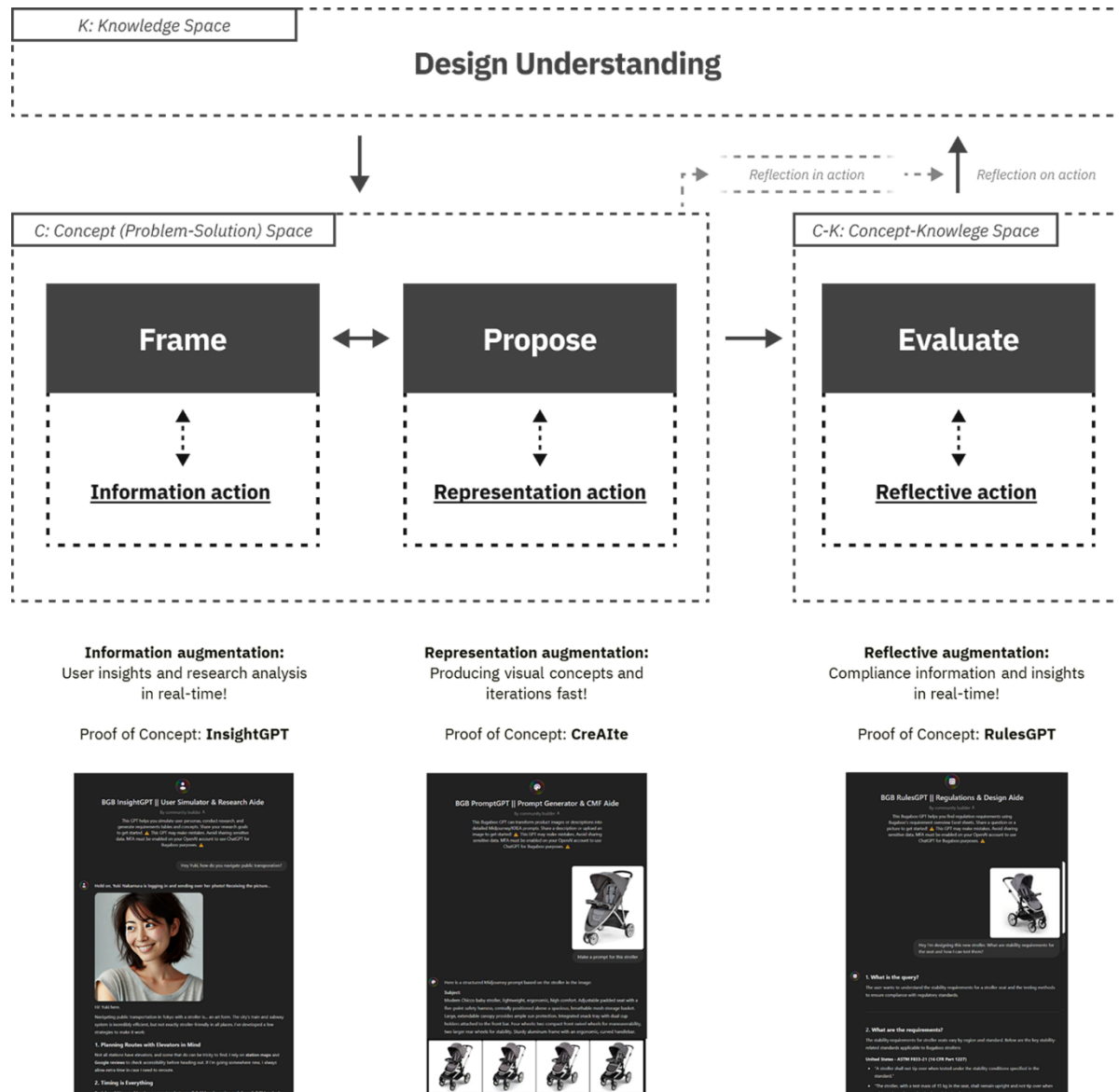
Through an Action Design Research (ADR) approach, three bespoke generative AI tools were co-developed and embedded into live design projects: InsightGPT (supporting information action during framing), CreAIte (enhancing representation action during proposing), and RulesGPT (facilitating reflective action during evaluation) (Figure 1).

The evaluation showed that integrating AI into the slower, uncertainty-driven phases around design improved the speed and richness of iteration cycles, acting as provocation engines without disrupting the intuitive rhythm of design. In the research sessions, designers spent less time on manual research and visualization and more on framing questions, refining prompts, interpreting outputs, and aligning stakeholders. Generative AI increased design agility, stimulated divergence, and accelerated iteration.

However, important limitations emerged, including decision fatigue from an overwhelming number of AI-generated options and a critical dependence on prompt design to ensure useful outputs. Human oversight remained indispensable for interpreting AI contributions and safeguarding the quality of design decisions. New literacies, particularly in prompt crafting and AI output validation, surfaced as essential competencies for effective use.

Importantly, while AI expanded the breadth of exploration, it did not resolve the core uncertainties inherent to design; instead, it amplified designers' ability to act amidst ambiguity. This reinforces the view that uncertainty is not a flaw to be eliminated but a creative resource to be navigated.

From these insights, the thesis formulates ten guiding principles and proposes a strategic roadmap for AI adoption in design-led organizations. Ultimately, it advocates for a mode of critical augmentation, where AI reshapes the rhythm of design while preserving its creative, empathetic, and judgment-driven roots.



**Figure 1.** Generative AI tools mapped to the Frame–Propose–Evaluate cycle: InsightGPT supports information action, CreAite aids representation, and RulesGPT enhances reflective action, helping designers navigate uncertainty and move between concept and knowledge spaces.

## Executive Summary

### *Context and Importance of the Problem*

In the evolving landscape of design and innovation, organizations face both the promise and risk of integrating AI into creative workflows. Generative AI technologies like large language models and image generators can accelerate research synthesis, ideation, and early prototyping, potentially expanding the problem–solution space and reducing iteration cycles, but may also increase design fixation, hinder originality, and blur human-AI collaboration. This thesis asks: what are the opportunities for generative AI to augment new product development, how can they be scaled, and what insights can be gained from its practical application in real-world design processes? The context is Bugaboo, an innovative juvenile product design company headquartered in Amsterdam, specializing in high-quality products for parents. Best known for its iconic strollers and smart mobility solutions for babies and toddlers, Bugaboo blends hands-on creativity, functional design, and user empathy to inspire parents worldwide.

This heritage raises a key question: can AI meaningfully augment Bugaboo's design and new product development process? To investigate this, the Frame–Propose–Evaluate (FPE) model was developed, capturing iterative cycles of framing problems, proposing alternatives, and evaluating directions through information, representation, and reflective actions, offering a practical lens to examine AI's role under real-world ambiguity.

### *Methodology and Tools Developed*

The thesis followed a two-phase Action Design Research approach, designed to stay close to the rhythms of real-world design practice. Rather than studying AI tools in isolation or in controlled experimental settings, the thesis embedded custom AI prototypes directly into Bugaboo's live design workflows. This collaborative, iterative approach ensured that findings remained closely anchored to real-world challenges, dynamics, and constraints.

Three generative AI prototypes were developed and aligned with the FPE model. InsightGPT supported information action during the Frame phase. It acted as a conversational AI assistant capable of rapidly gathering and synthesizing user insights, simulating dynamic personas, and surfacing contextual patterns, thereby giving design teams a head start in understanding complex and ambiguous problem spaces. CreAIte supported representation action during the Propose phase. Combining text-to-image generation tools such as Midjourney with a prompt-assistance system, CreAIte allowed designers to quickly externalize a broad range of visual concept variations, stimulating creative divergence and expanding the space of potential solutions early in the process. RulesGPT supported reflective action during the Evaluate phase. Trained on regulatory and compliance documents relevant to juvenile mobility products, RulesGPT allowed designers

to query for regulatory insights and feasibility constraints on demand, surfacing compliance requirements while design concepts were still flexible and adaptable.

Each tool was integrated into active projects with Bugaboo's design teams. Designers were invited to use InsightGPT during initial research and framing, CreAIte during ideation and early visualization sessions, and RulesGPT during concept development. Data collection methods included observation during tool use, reflection conversations, usage logs, and real-time feedback sessions. Altogether, sixteen design sessions, three reflective sessions, and numerous informal interventions were conducted, providing an empirical basis for evaluating the tools' impact on design work and for distilling generalizable insights.

### *Key Findings and Strategic Takeaways*

This thesis found that integrating generative AI into the slower, uncertainty-driven phases surrounding live collaboration improved the speed and richness of iteration cycles without disrupting the intuitive rhythm of design. Rather than altering the structure of design activity, AI intensified and redistributed certain aspects of it. Designers spent less time on manual synthesis, sketching, and regulation research, and more time framing sharper questions, refining prompts, interpreting outputs, and aligning stakeholders. Across the interventions, the Frame–Propose–Evaluate (FPE) model remained intact, and AI tools accelerated the flow of partial clarification, exploration, and reflection without replacing the foundational role of human judgment.

Each AI tool complemented a phase of the FPE model and supported corresponding uncertainty-reduction actions. InsightGPT, applied during framing, accelerated information action by synthesizing research and simulating personas, without substituting the need for validation. CreAIte, used during proposing, expanded the visible solution space through rapid visual generation, stimulating representation action, and promoting broader aesthetic exploration. RulesGPT, deployed during evaluation, surfaced feasibility and compliance constraints early, prompting reflective action while concepts remained flexible. Together, the tools fostered faster, more fluid iterations through framing, proposing, and evaluating cycles, encouraging earlier confrontation with ambiguity.

However, the research also surfaced important limitations. The abundance of AI-generated outputs sometimes overwhelmed designers, requiring deliberate convergence strategies such as editorial filtering and prompt tightening. Rather than advancing decisions, too much generative expansion occasionally led to stagnation. Furthermore, AI tools reflected biases inherent in their training data: InsightGPT often defaulted to mainstream user narratives, while CreAIte produced stylistic variants within conventional norms. Critical reframing and creative prompt crafting remained essential for achieving originality.

Importantly, the tools did not eliminate the need for empirical validation. AI outputs, whether synthesized personas, visual concepts, or regulatory summaries, require grounding in real-world constraints, brand identity, and user needs. Human oversight remained



indispensable, reinforcing that AI could enhance breadth, but depth, meaning-making, and convergence stayed the domain of human designers.

New competencies emerged as crucial for navigating AI-augmented workflows. Prompt literacy, editorial judgment, and iterative validation became central design skills. Designers shifted from merely generating content to orchestrating and interpreting AI-assisted outputs with discernment.

In conclusion, generative AI, when integrated thoughtfully and critically, reshapes the tempo and cognitive structure of design, supporting faster framing and broader exploration while preserving the evaluative rigor central to responsible product development.

### *Recommendations for Organizational Adoption of AI*

Building on the insights from the integration of InsightGPT, CreAIte, and RulesGPT at Bugaboo, the thesis formulates guiding principles and a roadmap for embedding generative AI into design-led organizations. At the foundation is the recognition that generative AI delivers value not by replacing designers but by acting as a provocation engine that stimulates exploration and broadens the conceptual landscape. AI tools are most effective when used early in the design process, before problem definitions harden, enabling designers to frame problems more richly, propose diverse solutions, and anticipate constraints. However, their outputs require critical interpretation, disciplined convergence, and context-aware judgment, reaffirming the indispensable role of human expertise.

The effective use of AI depends heavily on the development of new design literacies, particularly in prompt crafting and critical validation. The thesis observed that the quality of AI outputs correlates directly with the clarity and purposefulness of prompts; thus, prompting has become a new form of meta-design. Designers must actively frame exploration rather than passively receive AI outputs. Furthermore, while AI accelerates divergence, convergence must be designed: human teams must impose stopping points, select pathways deliberately, and remain vigilant about decision fatigue. AI mirrors existing patterns; innovation requires designers to challenge what the AI reflects, reframing prompts and critically steering outcomes.

To scale AI successfully, organizations must address both technological and cultural dimensions. Strategic alignment with organizational goals is essential: AI should enhance core capabilities, not be introduced for its own sake. Resources must be committed to building AI literacy through training programs, fostering hybrid roles such as prompt engineers, and investing in supportive infrastructure. A culture of safe experimentation should be cultivated, where cross-functional collaboration and iterative learning are encouraged. Governance frameworks must ensure transparency, traceability, and human oversight, embedding ethical safeguards and fostering trust in AI-assisted processes.

Adoption should follow a phased roadmap. Initial pilots can demonstrate value in live projects, capturing best practices while identifying gaps. In the medium term, AI should be embedded systematically into workflows, supported by clear templates, curated datasets, and evolving internal playbooks. Over time, AI should become a natural, visible, and trusted part of the organization's creative rhythm, not a standalone initiative. Ultimately, sustaining generative AI requires cultivating a learning culture that continually refines how AI is framed, used, and evaluated, ensuring that technology remains an amplifier of human creativity, not a distraction from it.

## *Outlook*

This research concludes that the integration of generative AI into design is not a disruptive transformation but a continuous co-evolution. Generative AI reshapes the rhythm of design by accelerating framing, proposing, and evaluating, while preserving convergence, judgment, and meaning-making as fundamentally human activities. The future lies in critical augmentation: AI will increasingly act as a cognitive partner, sharpening inquiry, broadening exploration, and enabling faster iteration without replacing human creativity.

For Bugaboo, embracing generative AI in early-stage design offers a significant strategic opportunity. When deployed with a human-centered mindset, AI can catalyze better design decisions and inspire more innovative products. It not only enhances efficiency in areas such as research synthesis and regulatory exploration but also stimulates broader creative thinking by providing unexpected perspectives. Moving forward, continually refining AI tools and embedding them thoughtfully into workflows will help maintain the necessary balance between divergent exploration and critical evaluation. Ultimately, the value proposition is clear: generative AI, used deliberately and responsibly, can help design teams expand their creative horizons, accelerate development cycles, and deliver high-quality products that meet user needs and compliance standards, while preserving the unique human touch that remains central to great design.

# Contents

1. Introduction.....	15
1.1. Objectives and Contributions.....	16
1.2. Addressed Research Gaps .....	17
1.3. Structure of the Thesis .....	17
2. Literature Review: Opportunities for Generative AI in New Product Development .....	19
2.1 Introduction: Where Generative AI Adds Value in NPD .....	19
2.2. AI for Design Analysis: Supporting Framing .....	19
2.3. AI for Design Synthesis and Simulation: Expanding Propositions .....	21
2.4. AI for Design Evaluation and Decision-Making: Supporting EvaluationReflection....	23
2.5. Conclusion: From What AI Can Do to What It Should Do .....	25
3. Research Approach: Action Design Research.....	27
3.1. Using ADR to Study AI in Real Design Teams .....	27
3.2. Phase 1: Finding the Right Opportunities for AI in NPD.....	27
3.3. Phase 2: Building, Testing, and Evolving AI Tools with Designers .....	28
PHASE 1: Opportunity Formulation.....	30
4. Grounding AI in How Design Happens at Bugaboo .....	31
4.1. Introduction: Understanding Real-World Design Before Using AI.....	31
4.2. Designing Under Pressure: Bounded Rationality in Action .....	32
4.3. What Makes Design Different: Generative, Not Just Decisional .....	32
4.4. Uncertainty as Fuel: How Designers Act When They Don't Know Yet.....	34
4.5. Frame, Propose, Evaluate: A Simplified Model of Design.....	37
4.5.1. FPE in Action: A Live Design Session at Bugaboo .....	38
4.6. Conclusion: Where AI Can Help — Augmenting FPE By Supporting Uncertainty Reduction Actions, Without Interrupting Flow .....	42
5. Finding the Right Use Cases for AI at Bugaboo .....	44
5.1. Introduction: Pinpointing Where Generative AI Can Help .....	44
5.2. Method: Mapping AI Opportunities to Real Design Needs.....	44
5.3. What Designers Need from AI: Insights from the Workshop .....	45
5.3.1. What Designers Love: Autonomy, Making, and Impact .....	45
5.3.2. What Gets in the Way: Friction Points in Daily Design Work .....	46

5.3.3. What If: Designers' Ideas for AI That Actually Help .....	48
5.4. From Insights to Concepts: Where AI Can Add the Most Value .....	50
5.4.1. Three Tool Directions Mapped to FPE .....	50
5.5. Conclusion: Mapping the Way for AI in Design .....	52
PHASE 2: Building, Intervention, and Evaluation .....	54
6. Phase 2 Approach: Development of Generative AI Tools via Action Design Research ....	55
6.1. The Cycle: Building, Intervention, and Evaluation .....	55
6.2. Reflection and Learning: How Designers and Tools Evolved Together .....	55
6.3. Formalization of Learning: What This Teaches Us About AI in Design.....	56
6.4. Data Collection Approach .....	56
7. AI for Framing: Exploring the Potential of InsightGPT to Augment Information Action ..	58
7.1. Introduction: InsightGPT and Early-Stage Framing at Bugaboo.....	58
7.2. Participants and Research Sessions .....	59
7.3 Study Material: How InsightGPT Works and What It Offers.....	59
7.3.1. InsightGPT Use-Cases: From Persona Creation to Integrated Desk Research..	60
7.3.2. Behind the Scenes: The Persona Creation Protocol.....	61
7.4. Developing InsightGPT: Interface and Design Rationale .....	63
7.4.1. Moving to ChatGPT: Conversational Interfaces for Fast, Flexible Insight .....	63
7.4.2. Seeing the User: Adding Visuals to Support Empathy and Imagination.....	63
7.5. Reflection and Learnings on AI-Augmented Information Action.....	64
7.5.1. What Worked: Strengths of InsightGPT in AI-Augmented Design Research.....	64
7.5.2. The Learning Moments: When InsightGPT Fell Short .....	66
7.6. Technology Acceptance (TAM) Assessment of InsightGPT .....	68
7.6.1. Perceived Usefulness: Best for Early-Stage Exploration.....	69
7.6.2. Perceived Ease of Use: Prompting Confidence Varies by Experience .....	69
7.6.3. Behavioral Intention to Use: Interest Is There, But Proof Still Needed .....	69
7.6.4. What This Means: Adoption Hinges on Guidance and Relevance.....	70
7.7. Conclusion: InsightGPT as a Provocation Engine for Early-Stage Research.....	70
8. AI for Proposing: Exploring the Potential of CreAIte to Augment Representation Action	73
8.1. Introduction: CreAIte and Early-Stage Proposing at Bugaboo .....	73
8.2. Participants and Research Sessions .....	74

8.3. Study Material: The CreAIte Workflow (PromptGPT + KREA + Midjourney).....	74
8.3.1. PromptGPT: Creating Better Prompts for Consistent Visual Output .....	76
8.3.2. KREA: Fast Exploration of Shape and Structure .....	77
8.3.3. Midjourney: Fine-Tuning Style, Detail, and CMF.....	78
8.4. Developing CreAIte: Interface and Design Rationale.....	79
8.4.1. Where AI Fell Short: Control, Consistency, and Brand Fidelity.....	79
8.4.2. Refinements: How Designers Made CreAIte More Reliable .....	80
8.4.2.4. Sketch-to-Concept:.....	83
8.5. Reflection and Learnings on AI-Augmented Representation Action .....	83
8.5.1. What Worked: Strengths of CreAIte in Rapid Visual Iteration .....	83
8.5.2. The Learning Moments: Where CreAIte Fell Short .....	85
8.6. Technology Acceptance (TAM) Assessment of CreAIte .....	88
8.6.1. Perceived Usefulness: Accelerating Concept Work, Especially Early .....	89
8.6.2. Perceived Ease of Use: Intuitive, but Prompt-Sensitive.....	89
8.6.3. Behavioral Intention: Cautious Enthusiasm to Adopt.....	90
8.6.4. What this Means: Strong Early Potential, Dependent on Quality and Fit.....	90
8.7. Conclusion: CreAIte as a Provocation Engine for Visual Exploration.....	90
9. AI for Evaluation: Exploring the Potential of RulesGPT to Augment Reflective Action ....	92
9.1. Introduction: RulesGPT and Compliance Checks at Bugaboo .....	92
9.2. Participants and Research Sessions .....	93
9.3 Study Material: How RulesGPT Supports Real-Time Compliance .....	93
9.3.1. How It Works: Step-by-Step Logic Behind RulesGPT .....	93
9.3.2. Building Trust: RulesGPT's System for Traceability and Transparency .....	94
9.4. Developing RulesGPT: Interface and Design Rationale .....	96
9.4.1. From Fluctuation to Fidelity: Anchoring Outputs in Verbatim Sources .....	96
9.4.2. Building Trust: Transparent Citations and Traceable Sources .....	96
9.4.3. Structuring for Usability: Standardized Outputs and Summaries.....	96
9.4.4. Acknowledging Gaps: Teaching the System to Say “No” .....	97
9.5. Reflection and Learnings on AI-Augmented Reflective Action .....	97
9.5.1 What Worked: Strengths of RulesGPT in Accelerating Compliance Research ....	97
9.5.2. The Learning Moments: When RulesGPT Fell Short.....	99

9.6. Technology Acceptance (TAM) Assessment of RulesGPT .....	100
9.6.1. Perceived Usefulness: Fast, Focused, but Role-Dependent .....	100
9.6.2. Perceived Ease of Use: Intuitive but Needs Further Source Integration .....	101
9.6.3. Behavioral Intention: Strong Interest, Shaped by Scope and Fit .....	101
9.6.4. What This Means: A Valuable Starting Point, With Room to Grow .....	101
9.7. Conclusion: RulesGPT as Embedded Compliance for Reflection .....	101
10. Formalization of Learning: From Tools to Transformation .....	103
10.1. Introduction: Embedding AI into Design Culture .....	103
10.2. Overall Observations: AI Reshapes Design Rhythm .....	103
10.3. Principles for Using Generative AI in Design Practice .....	105
10.3.1. AI as a Provocation Engine, Not a Replacementt .....	105
10.3.2. Prompting Is the New Design Literacy .....	105
10.3.3. Divergence Is Easy, Convergence Needs Design.....	105
10.3.4. Context Still Wins: Why Judgment Can't Be Automated.....	106
10.3.5. Keep Humans in the Loop to Build Trust and Ownership .....	106
10.4. The Ingredients to Embedding Generative AI (Across Bugaboo) .....	108
10.4.1 Laying the Organizational Foundation: .....	109
10.4.2. From Experiments to Scale: A Roadmap for Generative AI at Bugaboo .....	111
10.5. Thesis Conclusion: Generative AI Reshapes the Rhythm of Design .....	114
10.5.1. Limitations: Contextual Boundaries and Unanswered Questions .....	116
10.5.2. Future Research: What Needs to Be Explored Next .....	117
Epilogue: In the In-Between, AI Finds Its Place .....	118
References .....	120
Appendices .....	123
Appendix A - Describing the Frame, Propose, Evaluate Model .....	124
Appendix B. Workshop Analysis and Outcomes .....	128
Appendix C. Can AI-Generated Insights Be Trusted?.....	134
Appendix D. Technology Acceptance Model (TAM) Evaluation .....	137
Appendix E. Original Graduation Project Brief .....	141

# 1. Introduction

On the design floor of Bugaboo's Amsterdam headquarters, the creative process unfolds in a familiar rhythm: designers gather around a stroller prototype, moving fluidly between physical models and digital sketches, anchoring decisions in user research insights, regulatory requirements, and brand identity. Bugaboo, an innovative juvenile product design company, is internationally recognized for its iconic strollers and premium mobility solutions for babies and toddlers. With a longstanding focus on hands-on creativity, user empathy, and functional elegance, Bugaboo has set benchmarks for design excellence in the juvenile products industry. Against this backdrop, a new question lingers in the room: with tools like ChatGPT and Midjourney now at hand, what role can generative artificial intelligence (AI) play in the meticulous world of new product development (NPD)?

This thesis investigates that question by moving from curiosity to practice, embedding generative AI into real early-stage design workflows at Bugaboo to explore its influence on creativity and process (see Appendix E for the original project brief).

Emerging discussions and early practitioner evidence suggest that generative AI could accelerate product development. For example, Bilgram and Laarmann (2023) describe how large language models appeared to reduce iteration time and costs by enabling rapid exploration and prototyping. Similarly, Bouschery, Blazevic, and Piller (2023) propose conceptually that transformer-based models such as Large Language Models (LLMs) can expand the problem–solution space available to designers, potentially enhancing the breadth of ideation. However, these potential benefits come with important caveats. Wadinambiarachchi et al. (2024), in a controlled experimental study, find that exposure to AI-generated visuals can inadvertently increase design fixation and lower the originality, variety, and fluency of designers' outputs. Hwang (2022) cautions that unclear divisions of labor between human and AI contributors may hinder effective collaboration and introduce confusion into the design process. Similarly, Amankwah-Amoah et al. (2024) warn that without deliberate integration efforts, AI risks eroding the authenticity and brand ethos that are central to creative industries. Generative AI thus offers a double-edged proposition, potentially amplifying design capabilities while also introducing new challenges.

Rather than beginning from a position of disruption, this thesis investigates whether and how generative AI can be integrated meaningfully into an existing, effective design practice. Specifically, the research asks: *What are the opportunities for generative AI to augment new product development, how can they be scaled, and what insights can be gained from its practical application in real-world design processes?*

To investigate this question, I adopted an iterative, in-context methodology based on an Action Design Research (ADR) approach (Sein et al., 2011). This involved close collaboration with Bugaboo's designers through cycles of tool development and evaluation embedded within live projects. Rather than studying AI in isolation, the research intervened

directly in operational workflows, introducing generative AI tools into early-stage design practices and refining them through feedback to ground findings in practical realities.

The study focused on three uncertainty-driven design activities identified by Cash and Kreye (2017): information action (e.g. gathering and synthesizing user insights), representation action (e.g. proposing and visualizing design alternatives), and reflective action (e.g. evaluating feasibility and regulatory constraints). These activities were mapped to three stages of early concept development, framing, proposing, and evaluating, and identified as critical leverage points for examining where and how generative AI could most meaningfully support designers.

### 1.1. Objectives and Contributions

This thesis explores how generative AI can augment the early-stage new product development (NPD) process at Bugaboo. It focuses on identifying opportunities where AI tools can meaningfully support design activities during the framing, proposing, and evaluating stages of concept development. From this practical exploration, the thesis distills actionable principles for the responsible integration of AI into live design workflows.

To pursue this objective, three bespoke AI tools, InsightGPT, CreAIte Flow, and RulesGPT, were developed and deployed, each aligned with a phase of the Frame–Propose–Evaluate (FPE) model introduced in this thesis. This simplified model structures design into framing, proposing, and evaluating activities, each respectively supported by one of three critical uncertainty reduction actions: information action, representation action, and reflective action (originally termed *knowledge-sharing* action; Cash and Kreye, 2017). InsightGPT accelerated information action by aiding desk research and simulating personas. CreAIte expanded representation action through rapid visual generation of concepts. RulesGPT enhanced reflective action by surfacing regulatory constraints faster in the design process.

Integrating these tools revealed that generative AI did not alter the structure of design activities but intensified and redistributed effort. Throughout the sessions, designers shifted from manual tasks toward interpretation, prompting, and convergence. Iteration cycles became faster and framing, proposing, and evaluating more fluid, but the need for critical judgment and structured convergence remained essential.

The tools proved most valuable when treated as provocation engines, stimulating exploration without replacing human authorship. Prompting emerged as a critical design literacy, where the framing and specificity of inputs determined the quality of outputs. While AI made divergence easy, convergence still required deliberate human orchestration to prevent decision fatigue and ensure meaningful outcomes.

Despite accelerating exploration, AI consistently demonstrated limits in contextual reasoning. Outputs required validation against real-world constraints, brand identity, and



user needs. Generative AI enhanced breadth, but human designers remained essential for depth, interpretation, and meaning-making.

From these findings, the thesis formulates principles for integrating AI into design responsibly: using AI early, prompting with clarity, balancing divergence with convergence, grounding outputs in context, and maintaining human oversight to foster ownership.

Finally, the thesis proposes a roadmap for scaling AI integration in design-led organizations. Sustainable adoption depends on more than technical capability; it requires cultural openness, strategic alignment, governance frameworks, and a clear understanding of AI as an amplifier, not a substitute, for human creativity (Jöhnk, Weißert & Wyrski, 2021).

In sum, this research argues for a mode of critical augmentation: using generative AI to sharpen inquiry and expand exploration, while preserving the empathy, creativity, and judgment that remain central to responsible new product development. Generative AI can reshape the rhythm of design without displacing its roots.

## *1.2. Addressed Research Gaps*

While the potential of generative AI in design is increasingly acknowledged, its application within live, design-led organizations remains underexplored. Much of the existing research has focused on theoretical discussions or controlled experiments, offering limited insight into how AI behaves when embedded in real-world workflows. By integrating generative AI tools directly into Bugaboo's early-stage product development process, this thesis shifts the focus from speculative potential to applied augmentation. It provides a situated, empirical understanding of how AI can interact with uncertainty-driven design activities such as framing, proposing, and evaluating. In doing so, the research offers pragmatic insights into both the capabilities and limitations of generative AI in a live design context and proposes strategies for organizations aiming to integrate generative AI.

## *1.3. Structure of the Thesis*

To explore generative AI's role in augmenting new product development, this thesis is structured in two major phases: (1) Opportunity Formulation and (2) Building, Intervention, and Evaluation. Together, these phases span nine chapters, connecting theory and empirical experimentation, and progressing from conceptual framing to hands-on implementation within an active design setting.

### **Phase 1: Opportunity Formulation**

- **Chapter 2 – Literature Review:** Synthesizes recent literature on AI's evolving role in design, mapping insights to the basic design cycle. Key opportunities, such as AI-driven research synthesis, creative augmentation, and simulation, are highlighted to lay the groundwork for empirical exploration.

- **Chapter 3 – Methodology:** Introduces the Action Design Research (ADR) framework, chosen for its suitability to exploratory, practice-embedded work. ADR supports iterative prototyping and continuous feedback loops within a live organizational setting.
- **Chapter 4 – Grounding: Understanding Design at Bugaboo:** Documents Bugaboo's design culture, showing how teams navigate requirements, maintain brand identity, and work iteratively. Observational data clarify specific challenges, such as creative fixation and regulatory complexity, that might benefit from AI augmentation.
- **Chapter 5 – Identifying Opportunities for AI Integration:** Builds on Chapters 2–4 to pinpoint promising AI opportunities, aligned with both theoretical insights and Bugaboo's real-world needs. Three focal areas are selected: AI for user research, creative ideation, and regulatory checks, as well as structuring the roadmap for prototype development.

## Phase 2: Building, Intervention, and Evaluation

- **Chapter 6 – Iterative Co-Development of Generative AI Tools:** Details the development approach of the three AI prototypes, InsightGPT, CreAIte, and RulesGPT, following an ADR approach, with iterative testing and refinement.
- **Chapter 7 – InsightGPT for Early-Stage Research:** Focuses on the Frame phase (information action), describing how InsightGPT was deployed to accelerate user research and persona development. It examines the tool's impact on problem framing, user empathy, and potential pitfalls such as narrative overreliance.
- **Chapter 8 – CreAIte for Creative Ideation:** Explores the Propose phase (representation action), evaluating how a generative AI workflow expanded visual exploration. Field observations and designer feedback illustrate the interplay between AI-driven inspiration and human discernment.
- **Chapter 9 – RulesGPT for Regulatory and Decision Support:** Focuses on the Evaluate phase (reflective action), assessing RulesGPT's role in supporting early compliance checking by summarizing regulatory constraints, and emphasizing the continued need for human oversight.
- **Chapter 10 – Discussion and Integration:** Reflects on the overall effects of AI integration across the design process, synthesizes key design principles, and proposes a roadmap for broader organizational adoption. It discusses how generative AI reshapes the rhythm of design without displacing human-centered judgment and outlines directions for future research.

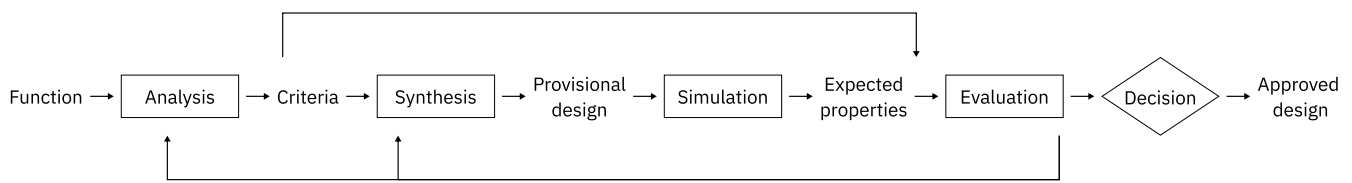
By structuring the thesis into these two complementary phases, opportunity identification and prototype evaluation, this work delivers both empirical and conceptual contributions. It

offers a nuanced understanding of how generative AI can be thoughtfully embedded into the dynamic rhythms of industrial product design.

## 2. Literature Review: Opportunities for Generative AI in New Product Development

### 2.1 Introduction: Where Generative AI Adds Value in NPD

As generative artificial intelligence continues to advance, it is increasingly regarded as a promising tool for augmenting and extending design practice, particularly within innovation-oriented settings such as new product development (Bouschery et al., 2023). This rapid literature review surveys how recent academic literature frames the opportunities offered by generative AI across the design process. To structure this inquiry, the review adopts a classical model of design (Figure 2), encompassing problem analysis, solution synthesis, simulation, evaluation, and decision-making (Roozenburg and Eekels, 1995).



**Figure 2.** Design process model by Roozenburg and Eekels (1995), used to identify where generative AI can augment key stages in new product development.

The purpose of the review is practical and exploratory. It does not attempt to comprehensively catalogue AI techniques; rather, it offers an initial mapping of use cases and proposed applications as identified in recent scholarship. The goal is to develop an intuition and working understanding of where generative AI is perceived to add value within design, and to identify relevant directions early in the thesis that can guide the formulation and refinement of research focus areas.

The review is followed by a phase-by-phase synthesis of AI's potential across the design cycle (Sections 2.2–2.6). Each section highlights specific tasks where AI is reported to add value. These insights are then used to support a narrowing of focus in Section 2.7, which concludes the review and sets up the generative AI emphasis of the thesis going forward.

### 2.2. AI for Design Analysis: Supporting Framing and Accelerating Information Extraction

In the early stages of the design process, where ambiguity is pronounced and the information landscape is often fragmented, qualitative, and unstructured, generative AI is beginning to demonstrate tangible analytical value. Rather than supplanting design

reasoning, recent literature highlights how generative and transformer-based models can serve as accelerators of early-stage sense-making, reducing the time and effort required to distill actionable insights from complex data sources.

Historically, AI has been viewed as best suited for data-heavy analytical tasks. For instance, innovation analytics approaches (Kakatkar, Bilgram & Füller, 2020) already leveraged AI to analyze innovation data before generative models became widespread. The arrival of LLM systems like GPT-3 has expanded these capabilities, especially in NPD, where teams are often faced with large volumes of unstructured qualitative input. Tools now perform advanced tasks such as text summarization, sentiment analysis, and the extraction of customer insights (Bouschery et al., 2023) from sources like product reviews.

Compared to earlier methods outlined by Fan et al. (2006) and Fan et al. (2012), contemporary generative AI provides greater nuance and speed, enabling the summarization of user research reports and market data at scale while extracting insights that would otherwise demand substantial manual effort. Tools like iki.ai and NotebookLLM act as intelligent research assistants, synthesizing information from diverse sources, documents, webpages, videos, and addressing early-stage information overload (Bouschery et al., 2023). These capabilities enhance the scalability and breadth of design research, allowing exploration of a wider range of user needs and problem frames. Holmström and Carroll (2024) further demonstrate how models like ChatGPT can automate large-scale text analysis across organizations, supporting a more AI-driven innovation approach (Cockburn, Henderson & Stern, 2018; Kakatkar et al., 2020; as cited in Bouschery et al., 2023). Additionally, Bilgram and Laarmann (2023) show that LLMs can convert complex qualitative data into structured outputs such as journey maps, helping to reveal latent patterns and reinforce the evidence base for design decisions.

A strategic framing of AI's potential is offered by Gama and Magistretti (2023), who categorize AI applications into three key roles: to replace, reinforce, and reveal. The 'reveal' function is particularly relevant here, emphasizing generative AI's potential to uncover hidden signals and emergent opportunities. Holmström and Carroll (2024) similarly point to AI's potential usefulness in foresight tasks, such as spotting market trends or organizing patent data through natural language categorization. Strategic tools like PESTEL analysis, too, can be performed by LLMs, as illustrated by Bilgram and Laarmann (2023).

Despite its significant promise, the literature highlights several critical limitations that temper the use of generative AI for insight extraction. LLMs generate responses based on probabilistic patterns rather than factual knowledge, which can result in outputs that sound plausible but are not necessarily accurate, a concern known as "*AI hallucination*" (Bouschery et al., 2023). These systems can produce fabricated or incorrect content without indicating uncertainty, raising concerns about reliability, especially since users may lack the ability to verify responses without prior knowledge (Fui-Hoon Nah et al., 2023). Kucharavy et al. (2024) and other contributors caution that trust in AI further erodes when

outputs are inconsistent or delivered with unjustified confidence, masking inaccuracies; they also warn that biases from training data and model behaviors persist as critical risks, alongside the danger of inadvertent leakage of sensitive information.

From a workflow perspective, outputs are often shallow or generic, requiring iterative prompting to yield meaningful insights, and without expert input, the quality and relevance of results may fall short in high-stakes or domain-specific contexts (Bilgram & Laarmann, 2023). Additionally, generative models face temporal data constraints, meaning that new developments beyond the training cut-off are not incorporated, limiting the timeliness and applicability of outputs in fast-moving design environments (Bouschery et al., 2023).

Taken together, these findings suggest that generative AI holds real potential in accelerating early-stage design research by transforming unstructured data into actionable insights, which is directly relevant to my broader investigation into how generative AI can meaningfully augment design practice. The opportunities outlined, such as accelerating research synthesis and surfacing user insights (Chapter 7), highlight clear areas where AI may complement human judgment during the early, ambiguous phases of product development. At the same time, the limitations emphasize the importance of thoughtful integration, critical prompting, and continued human oversight to ensure that AI enhances rather than detracts from the rigor and nuance of design decision-making.

### *2.3. AI for Design Synthesis and Simulation: Expanding Propositions and Accelerating Representations*

Where analytical tools help transform ambiguity into structured understanding, generative AI plays a different but complementary role in the synthesis phase: it opens up the conceptual space. Rather than operating as autonomous creators, generative systems are increasingly described in the literature as responsive agents, tools that stimulate ideation, support divergent thinking, and potentially enable more rapid exploration.

Perceptions of AI's relevance in this phase have shifted rapidly. A late-2022 survey by Füller et al. (2022) initially ranked ideation and prototyping as among the least promising stages for AI application. Yet with the rise of generative models, particularly LLMs and interfaces like ChatGPT, this view has evolved. These tools can now be integrated into creative workflows, marking a notable shift in how designers can approach early-stage synthesis (Bouschery et al., 2023; Bilgram et al., 2023).

One of the most significant contributions of generative AI in this phase is its capacity to expand the design space by producing a large volume of ideas rapidly. Tools such as ChatGPT can potentially generate novel product concepts or feature suggestions tailored to specific contexts, giving teams a broader range of initial directions (Holmström & Carroll, 2024). This aligns with prior research mentioned by Bouschery et al. (2023), indicating that expanding the breadth of external search can enhance innovation performance up to an

optimal level (Salter et al., 2015) and that a targeted, specialized search can also be advantageous depending on strategic context (Sofka & Grimpe, 2010).

At a practical level, LLMs can enact established creativity techniques like SCAMPER with minimal prompting. Bilgram and Laarmann (2023) demonstrate that ChatGPT can generate meaningful concept variations from sparse inputs, and Bouschery et al. (2023) note that few-shot prompting enables idea generation, even when problem briefs lack specificity. This suggests that AI could aid both incremental and potentially more radical innovation (Mariani & Dwivedi, 2024).

Generative tools might also help mitigate early fixation. Mariani and Dwivedi (2024) describe this potential as *“positive randomness”*, the unpredictability of AI outputs that can encourage unconventional solutions. Chiou et al. (2023) support this view, emphasizing the expanded conceptual space enabled by AI, while Berni et al. (2024) provide a structured account of how such systems might contribute by generating, refining, and transforming creative stimuli. These stimuli, often drawn from repurposed datasets, can catalyze analogical reasoning and stimulate new perspectives. For example, Requejo et al. (2024) document a case in which biological cell structures were reimaged into architectural forms, showcasing domain transfer as a pathway to novel connections.

While synthesis tools expand the conceptual field, AI-driven simulation plays a critical role in accelerating the journey from idea to evaluable artefact. Across the literature, AI is increasingly portrayed as a co-creative partner in early-stage prototyping, facilitating exploratory iteration, enabling cross-domain recombination, and supporting real-time visual refinement. These capabilities help design teams traverse broad solution spaces quickly, balancing experimental openness with scalable output.

Diffusion models, capable of generating images from text, are becoming especially instrumental in early visualization. By externalizing concepts with minimal cognitive or technical overhead, these tools support fast clarification of nascent design directions. Kim (2024) shows how these systems allow exploration of multiple pathways without the effort required by traditional rendering.

Serra (2024) highlights that even low-fidelity inputs such as black-and-white sketches can be enhanced into more refined visual assets, helping accelerate downstream refinement. Tools like Vizcom, KREA, and Midjourney exemplify this capability, converting rudimentary sketches into realistic product renders. Vizcom additionally supports the transformation of 2D sketches into 3D models, which designers can inspect from various perspectives or use for 3D printing in form studies, while text-to-video tools such as Luma allow designers to prototype motion and interaction, providing animated sequences that help communicate functionality. Bilgram and Laarmann (2023) demonstrate that even non-technical stakeholders can now use LLMs to generate *“early look-and-feel”* prototypes. As they note, *“it is easier and less time-consuming to edit a [draft] version than to produce the initial thoughts”* (p. 24), highlighting AI’s utility as a starting point for refinement. This capability

aligns with Amankwah-Amoah et al.'s (2024) assertion that generative AI can streamline manual design tasks and help teams reach testable prototypes with less overhead.

Despite their promise, generative AI tools introduce several critical limitations. Wadinambiarachchi et al. (2024) found that exposure to AI-generated images led participants to produce fewer, less varied, and less original ideas than those in a control group, suggesting that such tools may inadvertently reinforce fixation rather than alleviate it. This aligns with broader concerns that AI's reliance on existing data can constrain creative divergence (Amankwah-Amoah et al., 2024; Holmström & Carroll, 2024). In collaborative ideation settings, participants in Kim's (2024) study reported that while generative outputs appeared expansive, they could feel conventional or fragmented, lacking the perceived innovation of manually curated alternatives such as Pinterest boards.

Moreover, the reliability of AI outputs remains uncertain, particularly in domains with uneven training data (Bouschery et al., 2023), and explainability gaps further undermine user confidence; outputs are probabilistic (dependent on chance) and difficult to trace (Kim, 2024). Prompt sensitivity exacerbates this challenge, with system performance often hinging on precise, standardized input structures (Yin et al., 2023). In fields like fashion design, generative results may fall short of sociocultural nuance or brand coherence, occasionally reproducing stereotypes or raising intellectual property concerns due to training data provenance (Kim, 2024). Finally, while useful in early exploration, AI-generated visuals can lack the fidelity required for final decision-making (Bilgram & Laarmann, 2023), and as Yin, Zhang, and Liu (2023) caution, user interpretive bias may shape the uptake of AI-suggested directions in ways that compromise commercial or technical viability.

As a whole, these findings indicate that AI is becoming an essential aid in early-stage design by enabling ideation and visualization at scale (Chapter 8). In synthesis, generative AI can extend the conceptual range through rapid idea generation and cognitive stimulation. In simulation, it reduces manual effort by producing testable prototypes and visual representations. These roles are particularly relevant to my broader investigation into how AI can support design exploration. However, the risks of conventionality, fixation, bias, and dependency underscore the need for careful integration, ensuring that AI complements rather than constrains critical, context-sensitive design judgment.

## *2.4. AI for Design Evaluation and Decision-Making: Supporting Evaluation and Structuring Reflection*

As speculative ideas give way to viable design candidates, the roles of evaluation and decision-making intensify. At this juncture, AI transitions from being an ideation catalyst to an evaluative and decision-support agent, embedded co-reflectors that accelerate convergence, highlight overlooked improvements, and compress procedural burdens.

In evaluation, AI contributes by enhancing both analytical and generative capabilities. Generative AI can support simulation-based user engagement. Holmström and Carroll (2024) describe how tools like ChatGPT can generate user personas, simulate interview scenarios, and model usage contexts, allowing conceptual outcomes to be assessed within iterative cycles. These interactions offer a form of anticipatory feedback. Mariani and Dwivedi (2024) describe how generative AI can simulate or integrate stakeholder and user input, enabling innovation managers to “*validate their assumption in near real time*” (p. 13). This capacity to reduce the temporal lag between prototype creation and user response has clear implications for agility in evaluation. Duan et al. (2024) developed a technique using LLMs to generate automatic feedback on UI mockups, essentially turning the model into a pseudo-“*design critic*” capable of identifying usability issues or suggesting improvements based on learned guidelines.

Further, Serra (2024) identifies how AI can streamline compliance by identifying and incorporating relevant standards into draft test protocols. Holmström and Carroll (2024) suggest “*automated concept testing*,” where generative systems produce test plans, interpret feedback, and propose alternatives using natural language processing. AI also contributes operationally, acting as a meeting assistant (Serra, 2024), drafting interview guides, or developing personas, as Bilgram and Laarmann (2023) demonstrate. These tools speed up output generation and offer guidance in early-stage structuring.

In decision-making, AI can function as a system that supports judgment under constraint and a scaffold for team coordination. LLMs are effective in synthesizing complex design-relevant knowledge into actionable insights. Bouschery et al. (2023) describe how LLMs can summarize user feedback and design documentation, making large volumes of qualitative input manageable. Requejo et al. (2024) illustrate how AI assists in material selection and contextual visualization of concepts (see also Serra, 2024). Grandi et al. (2025) found that although AI-generated material recommendations often diverge from expert choices, this discrepancy can spur designers to reconsider alternatives and clarify their rationale.

However, these capabilities are accompanied by important limitations. Research shows that while AI can simulate dynamic persona interactions, it has not led to significant improvements in design outcomes or user insight depth (Gu, Chandrasegaran, & Lloyd, 2025), and it remains prone to fabricating content (Bang et al., 2023). LLMs also exhibit limited structured reasoning, often underperforming in numerical tasks (Bang et al., 2023), and frequently present fabricated information as fact (Rawte et al., 2023). Gu et al. (2025), drawing on Redifer et al. (2019), warn that the effort required to interpret and verify AI outputs may increase designers’ cognitive load, potentially hindering the creative flexibility essential for effective evaluation.

In decision-making contexts, additional constraints emerge: in research on material selection, AI-generated recommendations tended to cluster around a narrow set of options

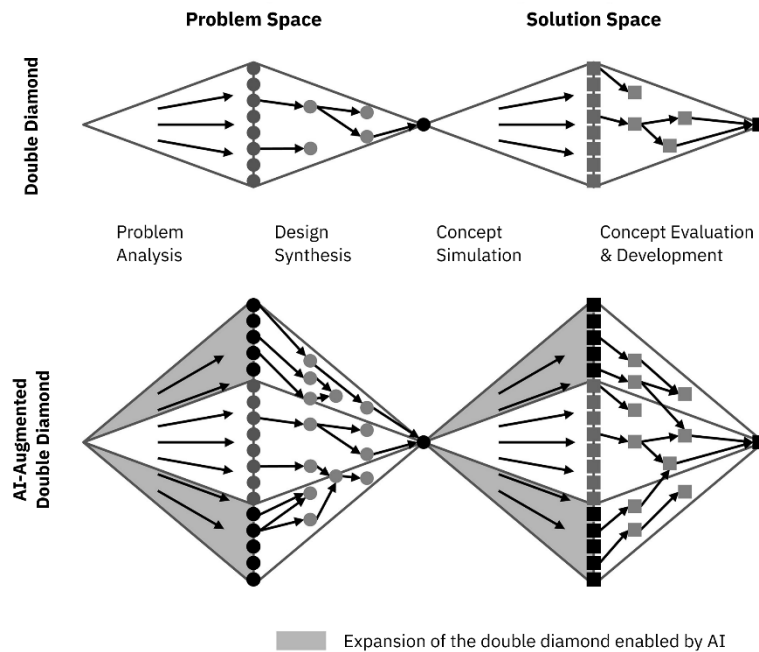


and often overrate their appropriateness, restricting exploratory breadth (Grandi et al., 2025). Designers lacking domain-specific knowledge may be unable to critically evaluate AI outputs (Bouschery et al., 2023), while the human-like language of LLMs can distort perceptions of authorship and credibility (Jakesch et al., 2023); additionally, LLM agents that challenge either AI recommendations or group consensus can shift how groups rely on AI advice (Chiang et al., 2024).

In sum, AI holds growing potential to support the converging stages of design by accelerating and aiding evaluation and simulating stakeholder input (Chapter 9). These contributions align with the broader investigation into how generative AI can support design practice. By compressing feedback loops and prompting reflection, AI augments designers' ability to converge. Yet, the constraints, fabrication, limited reasoning, and cognitive overhead underscore the need for AI to act as an aid to, not a replacement for, robust human judgment.

## *2.5. Conclusion: From What AI Can Do to What It Should Do*

Across the preceding sections, this literature review has traced the expanding role of artificial intelligence in design, from data-driven research and idea generation to prototyping, evaluation, and team coordination. A consistent theme across all phases of the design cycle is generative AI's capacity to accelerate throughput and broaden the range of explored options. This expanded exploratory potential is visualized in the AI-augmented Double Diamond model (Figure 3), as proposed by Bouschery et al. (2023), which illustrates how AI extends both the problem and solution spaces. Whether through persona synthesis, concept variation, simulation-based critique, or scenario modelling, AI is increasingly positioned as an augments of core design competencies.



**Figure 3.** Original Double Diamond (above) and AI-augmented Double Diamond (below), showing how generative AI expands divergence in both problem and solution spaces to enable broader design exploration (adapted from Bouschery et al., 2023; based on Marion & Fixson, 2019)

Unlike optimization engines or domain-specific automation tools, generative models, such as large language models and diffusion-based visual tools, are shown to be uniquely flexible, immediately deployable, and designed for open-ended interaction. As shown in the reviewed literature, these tools can assist in diverse tasks, including summarizing user research, generating product ideas, visualizing concepts, simulating user interactions, and structuring design tasks. Their value lies not only in the quality of the content they produce, but also in their immediacy, accessibility, and capacity to integrate into live, iterative design processes. Given their immediacy and versatility, this thesis purposefully narrows its focus to generative AI tools.

At the same time, a critical insight emerged while reading this particular literature: it emphasizes what AI *can* do, its technical capabilities, and much less what it *should* do in the context of real-world design practice. Additionally, as Jöhnk et al. (2021) note, successful AI adoption requires not only technology, but also organizational readiness, a topic explored further in Section 10.

Recognizing this gap within the reviewed literature gives rise to the core inquiry of this research: how and for what purpose should generative AI tools be used in the intuitive workflows that define new product design at Bugaboo? In response, the next phase of this thesis moves from a theoretical examination of AI's potential to a practical investigation. It aims to explore when and how generative AI tools can be purposefully and effectively applied in the context of design innovation. The following chapter outlines the research methodology developed to guide this inquiry.

## 3. Research Approach: Action Design Research

### 3.1. Using ADR to Study AI in Real Design Teams

To investigate how AI could be meaningfully integrated into everyday industrial design work, I adopted the Action Design Research (ADR) methodology (Sein et al., 2011). ADR draws on both action research, which focuses on solving real problems alongside practitioners, and design research, which focuses on creating and improving technological artifacts. It was well-suited for this thesis because of its dual focus: it supports the development of new technological artefacts while simultaneously studying how they shape, and are shaped by, organizational realities.

Alternative methodologies were considered but ultimately deemed less appropriate. Ethnographic and qualitative case study approaches provide rich contextual understanding but do not support iterative artifact development or intervention. Controlled experiments, while high in internal validity, abstract away from the messy, dynamic realities of collaborative design work. ADR was chosen because it uniquely enables iterative building, in-situ intervention, and real-time evaluation, capturing the reciprocal shaping between AI tools and their organizational context.

Rather than separating development and evaluation into distinct, sequential stages, ADR embeds interventions directly into practice, enabling continuous observation, feedback, and adaptation. As shown in Figure 4, the research unfolded in two phases, corresponding to ADR's stages of 1) Opportunity Formulation (Chapters 5 and 6) and 2) Building–Intervention–Evaluation (Chapters 6 to 9), ultimately leading to Formalization of Learning (Chapter 10). Throughout both phases, the research remained closely anchored to the real working context at Bugaboo, ensuring that findings were both practically relevant and theoretically informed.

### 3.2. Phase 1: Finding the Right Opportunities for AI in NPD

The first phase of the research focused on identifying where AI could deliver real benefits within Bugaboo's design process. To ground opportunity discovery in real practice, I combined empirical fieldwork with theoretical framing. Shadowing multiple design teams allowed me to observe daily workflows firsthand and revealed patterns of activity across different projects. Synthesizing these observations with design theory led to the development of the Frame–Propose–Evaluate (FPE) model, a simplified model of design work structured around cycles of uncertainty reduction. In this model, framing problems involves information actions, proposing ideas involves representation actions, and evaluating alternatives involves reflective actions.

Building on this theoretical foundation, I organized a structured workshop with designers to identify where AI support could be most impactful within these activities. The workshop

surfaced three recurrent practical challenges: the heavy manual effort required to synthesize user research and external information, the slowing of creative momentum during early-stage concept development, and the difficulty of navigating regulatory compliance requirements. These insights led to the formulation of three tool concepts. InsightGPT was conceived to accelerate and structure information synthesis during framing. CreAIte was developed to broaden and speed up visual exploration during proposing. RulesGPT was designed to support earlier and more accessible regulatory evaluation during concept development.

Throughout Phase 1, the involvement of designers, design leads, and other stakeholders was continuous. This ensured that opportunity discovery remained tightly coupled to the organization's real-world constraints and priorities and built the trust and access necessary for embedding experimental AI tools into live projects. The outcome of Phase 1 was therefore not only a theoretical opportunity map but also an organizational foundation for the next phase of action.

### *3.3. Phase 2: Building, Testing, and Evolving AI Tools with Designers*

In the second phase, I moved from opportunity discovery to tool development and intervention. Following ADR's Building–Intervention–Evaluation cycle, I designed and developed the three tools, InsightGPT, CreAIte, and RulesGPT, each aimed at augmenting a specific phase of the Frame–Propose–Evaluate model by supporting a corresponding uncertainty reduction action. Development was iterative and practitioner-centered, with early versions shaped directly by the needs identified in Phase 1.<sup>1</sup>

Rather than evaluating the tools in controlled conditions, I embedded the prototypes directly into ongoing product development projects. Designers used the tools on real deliverables, under real deadlines, and within established team structures. This in-situ deployment allowed me to observe not only functional tool performance but also their broader influence on the design process. Designers engaged with the tools naturally, and their spontaneous reactions and adaptations provided critical insights into tool effectiveness and integration challenges.

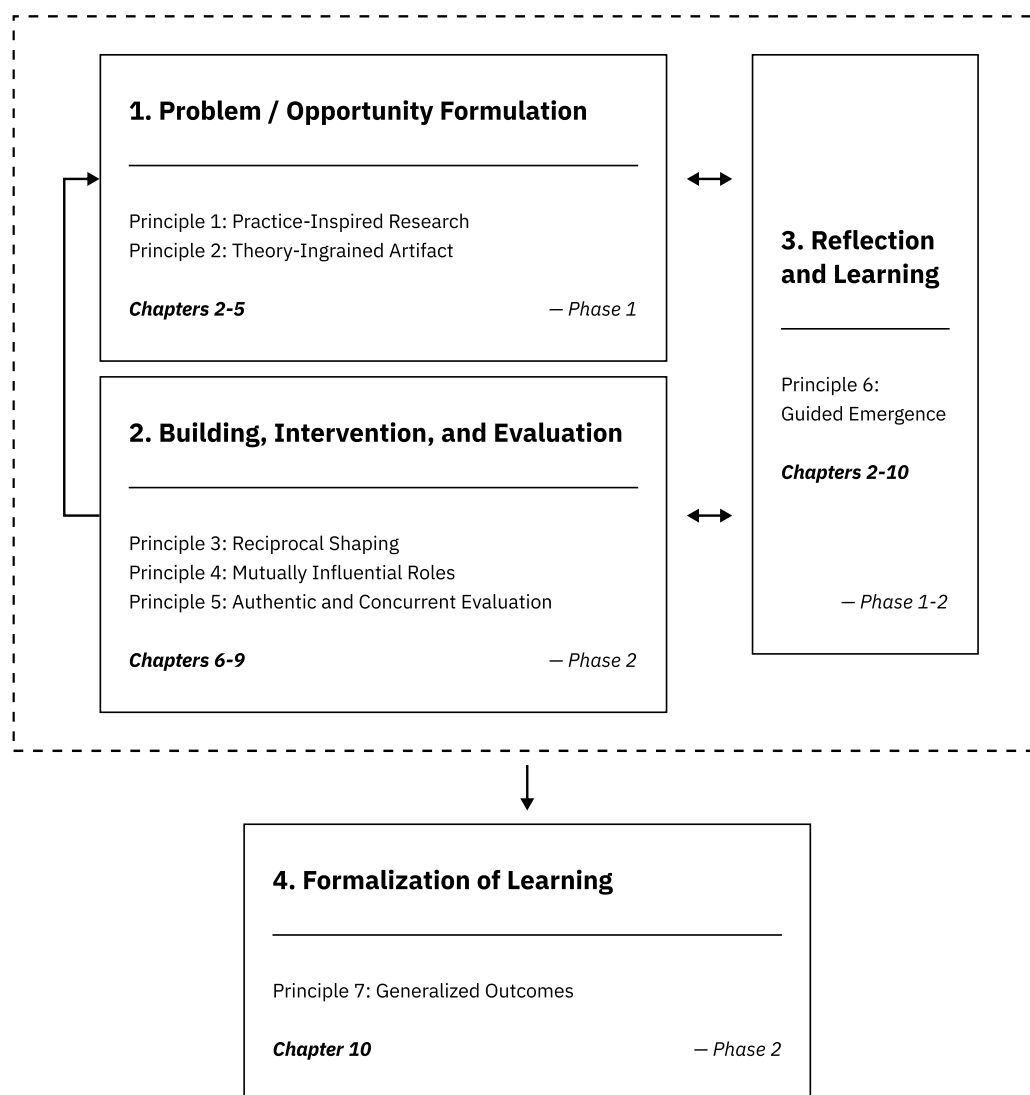
Evaluation and reflection were continuous throughout Phase 2. I collected real-time observations and conducted reflection conversations after tool use. Feedback from these sessions informed rapid cycles of refinement, with adjustments to prompts, tool behaviors, and workflows made in response to issues encountered in practice. At the same time, I continuously assessed both tool performance and designer interaction, identifying where the tools effectively supported design activities and where they fell short. These reflections, documented in Chapters 7 to 9, guided the evolution of the tools and the adaptation of the research focus over time. They also laid the groundwork for the formalization of learning,

---

<sup>1</sup> The detailed approach for Phase 2 is outlined in Chapter 6.

where insights from the interventions were consolidated into generalizable principles and a roadmap for the future integration of AI tools in design practice.

The final stage of ADR, formalization of learning, involved abstracting insights gained from the specific research setting into generalizable knowledge that can inform broader practice and theory (Sein et al., 2011). In this thesis, this process is realized in Chapter 10, where the outcomes of the Bugaboo intervention are consolidated into principles, an integration roadmap, and transferable insights for AI-augmented new product development. Although the prototypes and findings emerged from a specific organizational setting, the insights have been abstracted to offer value to a wider audience of designers, researchers, and leaders working in comparable contexts.



**Figure 4.** Adapted Action Design Research (ADR) process illustrating the iterative approach used to integrate AI tools within real-world design practice at Bugaboo. The research unfolded across three stages: Opportunity Formulation (identifying meaningful AI intervention points in Bugaboo’s NPD process), Building–Intervention–Evaluation (developing and embedding AI tools into live projects), and Formalization of Learning (distilling generalizable principles for AI-augmented design). Adapted from Sein et al. (2011).

# PHASE 1: Opportunity Formulation

*The first phase of the thesis, comprising Chapters 4 and 5, lays the conceptual and empirical foundation for identifying meaningful roles generative AI might play within the new product development process at Bugaboo. Rather than beginning with assumptions about what AI should do, this phase begins with a careful investigation into what design is, both in theory and in practice, and then methodically maps where AI integration would be both feasible and valuable.*

*Chapter 4 sets the stage by exploring some of the most influential ideas in design theory. Drawing on the work of Simon (1956; 1972), Hatchuel (2001), Hatchuel and Weil (2003), Schön (1979), as well as Cash and Kreye's (2017) Uncertainty-Driven Action (UDA) model, it builds a picture of design as an iterative, reflective, and adaptive process. In this view, design is not a fixed sequence of steps, but a dynamic activity shaped by ambiguity, exploration, and constant reframing. To connect these theories to the realities of Bugaboo's design culture, the chapter introduces the Frame–Propose–Evaluate (FPE) model. Based on direct observations of design teams at work, I formulated this simplified model of design, which describes the design process to translate abstract theory into a hands-on lens for understanding where AI could be woven into design, without disrupting the creative rhythm.*

*Building on this theoretical and observational foundation, Chapter 5 shifts focus to identifying concrete opportunities for generative AI. It brings together insights from the academic literature on the opportunities for AI in design with the outcomes of a collaborative workshop involving Bugaboo designers. The result is a clearer picture of the recurring friction points teams experience, such as the time-consuming nature of user research, challenges in maintaining creative momentum, and the complexities of regulatory decision-making. These challenges are then mapped onto the FPE model, allowing me to pinpoint where AI could have the greatest impact. From this process, three concepts emerge: InsightGPT, aimed at synthesizing user insights during the framing stage; CreAIte, designed to support idea generation; and RulesGPT, which helps designers consider compliance during evaluation.*

*Together, Chapters 4 and 5 shift the conversation away from general discussions about AI's potential and toward grounded, context-specific interventions. They move from theory to observation, and from broad possibility to targeted application. This phase doesn't just prepare the ground for building tools, but it also provides a strategic backbone for the entire thesis. Rooting AI development in a deep understanding of both design thinking and everyday practice ensures that the tools built in the next phase are not just technically feasible but aligned with the needs, values, and working rhythms of design teams.*

## 4. Grounding AI in How Design Happens at Bugaboo

### 4.1. Introduction: Understanding Real-World Design Before Using AI

Design at Bugaboo unfolds not through rigid plans, but through adaptive cycles shaped by ambiguity. Faced with shifting constraints, changing regulations, evolving user needs, or supply chain limitations, designers move forward without perfect clarity. They make progress by acting under uncertainty, cycling rapidly through framing problems, proposing solutions, and evaluating outcomes. This chapter examines how such a process works in real-world conditions and where generative AI can meaningfully enhance it.

Rather than optimizing fixed problems, Bugaboo's design teams operate within what Simon (1956, 1972) called *bounded rationality*: they satisfice, making the best possible decisions with limited time, information, and cognitive capacity. But design is not just about choosing, it's about creating. Hatchuel's (2001) theory of *expandable rationality* highlights that designers do not merely select among known options; they generate entirely new ones by moving between the knowledge space (K-space) and the conceptual space (C-space) (Hatchuel & Weil, 2003), often through sketches, prototypes, and discussions.

Uncertainty, then, is not a barrier; it is a resource. Designers respond with deliberate, constructive actions. Drawing on the *Uncertainty-Driven Action (UDA)* model (Cash & Kreye, 2017), this chapter identifies three core behaviors: information action (seeking data to clarify gaps), representation action (externalizing ideas through artifacts), and reflective action (individual or shared sense-making). These are the moves that keep design in motion, especially when the way forward is unclear.

To observe and structure these cycles, I introduce the *Frame–Propose–Evaluate (FPE)* model, a simplified model of design developed through observation at Bugaboo. FPE captures how designers define challenges, generate alternatives, and assess directions, not in linear order, but as overlapping moves responding to uncertainty.

This chapter argues that generative AI is best positioned not within the rapid core of live ideation and design, but around it, supporting the uncertainty-driven actions that fuel FPE. AI can accelerate information action by synthesizing or simulating research; it can support representation action by generating quick visual or conceptual variations; and it can enhance reflective action by helping structure or simulate insights or stakeholder input.

Ultimately, generative AI's role is not to automate creativity, but to amplify the designer's capacity to act amidst uncertainty. When aligned with the natural cadence of FPE, AI becomes a partner in the generative process, one that can strengthen design without interrupting its rhythm.

## 4.2. Designing Under Pressure: Bounded Rationality in Action

Understanding how designers make decisions under real-world constraints is critical for identifying where and how generative AI might play a supportive role in the design process. To ground this inquiry, I begin with the concept of bounded rationality, a foundational idea from Simon (1956, 1972) that reshaped how we understand human decision-making. Rather than assuming individuals behave as fully rational agents who optimize across all known possibilities, Simon argued that real-world decisions are made under significant constraints: limited time, incomplete information, and cognitive limitations. People use *heuristics*, mental shortcuts, and pursue solutions that are “good enough,” a process he termed *satisficing*.

This principle is particularly relevant in the context of industrial design at Bugaboo. Projects are often shaped by volatile variables, new ergonomic requirements, changing supplier constraints, updated safety regulations, or evolving stakeholder priorities. In this context, satisficing is not a fallback strategy; it is a rational response to complexity. Designers must quickly generate and assess ideas within time-boxed phases, constrained resources, and incomplete information. The goal is not to find the perfect solution but a viable one that is safe, manufacturable, cost-effective, and aligned with brand values. Progress hinges not on exhaustive analysis but on timely judgment and forward movement.

This perspective on bounded rationality is especially relevant to the second phase of my project (Chapters 7 and 9), which examines how AI can support framing and evaluating within real-world constraints. In design contexts where speed, sufficiency, and adaptability matter more than optimization, generative AI tools can be especially useful when they enable understanding and support confident decision-making under pressure. Rather than aiming to compute the “best” solution, which misrepresents the messy, iterative nature of real-world design, AI can be aligned with bounded decision-making, offering support that is fast, flexible, and good enough to maintain momentum, such as quickly surfacing key user insights or extracting relevant regulatory requirements without the need to sift through pages of information. This approach helps ensure that progress is sustained even under significant time and resource constraints.

## 4.3. What Makes Design Different: Generative, Not Just Decisional

While bounded rationality provides a useful lens for understanding how designers make decisions under constraint, it does not fully capture the generative nature of design, where the space of possible solutions is not simply navigated but actively constructed. In contrast to classical decision-making, where the task is to choose among predefined alternatives, design is fundamentally expansive. It involves formulating new concepts, reframing problems, and discovering unknown opportunities. Understanding this difference is essential when considering the role of generative AI in design: AI must not only support selection but also contribute to the creation of what does not yet exist. This expansive

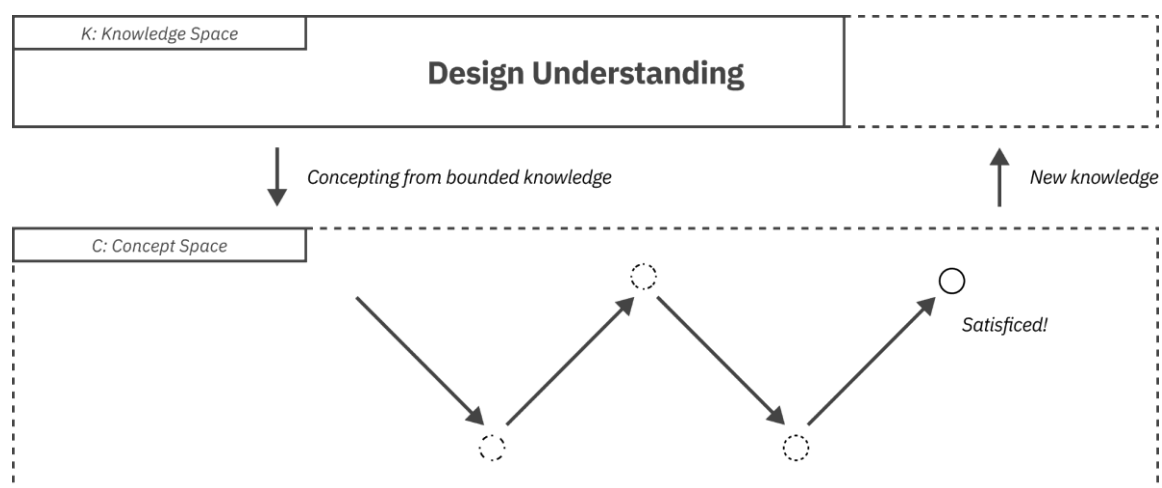


quality of design is articulated in Hatchuel's (2001) theory of expandable rationality, which challenges the assumption that rational problem-solving is confined to choosing among existing alternatives. Hatchuel (2001) argues that in design, rationality evolves through creative inquiry.

Hatchuel and Weil's (2003) C–K Theory formalizes this process of moving between what is known and what is conceivable. Designers do not merely operate within a closed space of options; they work across two distinct but interconnected spaces, the 1) C-space (Conceptual Space), the realm of emerging ideas, tentative directions, and untested hypotheses and 2) the K-space (Knowledge Space), the repository of validated facts, design precedents, technical constraints, and market insights.

A design concept might begin as a speculative idea in C-space, such as a novel folding mechanism or a new modular seating strategy, and then be tested against existing knowledge in K-space, including safety standards, manufacturing capabilities, or user preferences. If validated, the concept enriches K-space, expanding the organization's overall design intelligence.

At Bugaboo, this process is clearly visible. Designers often draw from the K-space, say, known data or prior test results, to spark new configurations or functionalities in the C-space. A seemingly minor prototype variation may uncover an unforeseen user interaction or mechanical advantage. If viable, it feeds back into the team's shared knowledge base, informing future projects and broadening the bounds of what is considered possible or feasible. Critically, this means that design does not follow a fixed roadmap. It is a mode of inquiry that moves between what is known and what could be (Figure 5).



**Figure 5.** Based on Hatchuel and Weil's (2003) C–K Theory, the figure illustrates how designers move between bounded rationality—working with existing knowledge in the K-space—and expandable rationality, where new concepts are developed in the C-space. As concepts are tested and validated, they enrich the K-space, expanding what is considered possible. This cyclical process reflects how Bugaboo teams advance design understanding through iterative exploration and knowledge-building.

Understanding this dynamic has direct implications for integrating generative AI into the early phases of design, where ambiguity and conceptual exploration are central. In traditional optimization contexts, AI performs well within well-defined problem spaces. Design, however, is fundamentally different; its boundaries are often fluid, still in the making. To contribute meaningfully, generative AI should be positioned not merely as a decision support tool but as a co-explorer within the conceptual space (C-space), capable of provoking new directions, generating speculative alternatives, and enriching the interplay between existing knowledge (K-space) and imaginative projection.

This framing defines the second phase of my thesis (Chapter 8), which investigates how AI can actively expand the conceptual C-space and catalyze creative synthesis during early-stage design. In this phase, generative AI is positioned not as a tool for narrowing options but as a co-explorer of possibilities, an active agent that could challenge boundaries, reveal hidden opportunities, and intensify the dialogue between established knowledge and emerging ideas. The emphasis is on generative support: deploying tools that stimulate creative inquiry, foster lateral exploration, and encourage designers to transcend habitual thinking, all while maintaining alignment with practical and contextual constraints.

Technologies such as large language models and diffusion-based image generators are particularly well-suited to this role when deployed thoughtfully. By recombining known design references, offering novel interpretations of prompts, and visualizing alternatives that diverge from conventional patterns, these systems empower designers to traverse and extend the conceptual landscape.

In this way, expandable rationality reshapes not only how we define design activity but also how we conceive of generative AI's role within it. Rather than solving predefined problems, generative AI can be used to enrich the conceptual dialogue, stimulate exploration, diversify thought trajectories, and amplify the generative capacities of human designers, setting the stage for the next section on uncertainty as a generative force.

#### *4.4. Uncertainty as Fuel: How Designers Act When They Don't Know Yet*

Understanding how designers respond to uncertainty is critical when considering how generative AI might meaningfully support the design process. Rather than replacing human decision-making, AI should assist designers in navigating ambiguity, particularly in moments when information is incomplete, ideas are still forming, and clarity has yet to emerge. The Uncertainty-driven Action (UDA) model by Cash and Kreye (2017) captures this concept well, offering a descriptive account of how designers respond constructively to uncertainty. It identifies three interrelated types of action, information action, representation action, and knowledge-sharing action (referred to more broadly as *reflective action* in this thesis) that enable teams to transform ambiguity into insight and forward momentum. Instead of stalling in the face of the unknown, designers engage in deliberate, often collaborative activity to keep the process moving:

### 1. Information Action

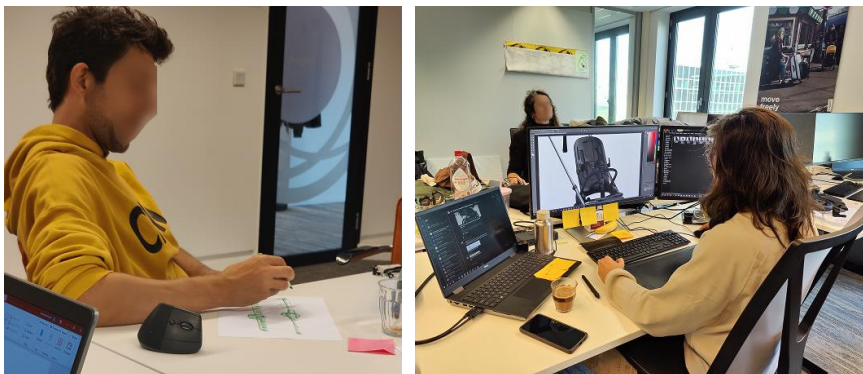
When faced with ambiguity, designers gather, analyze, and transform data to close knowledge gaps. For example, the Bugaboo team might conduct desk research to study the market, review insights from past designs, or create moodboards of potential materials to inform ongoing decisions (Figure 6).



**Figure 6.** Examples of information action: archiving prototypes and assembling material moodboards

### 2. Representation Action

In the face of uncertainty, designers externalize their ideas through sketches, mock-ups, prototypes, and digital simulations. These artifacts, described as learning devices, generate material feedback that makes abstract ideas tangible. By interacting with representations, designers expose flaws, surface unexpected constraints or affordances, and refine both the problem framing and proposed solutions. Sketching or creating a 3D model, for example, can show that the design looks bulkier than expected (Figure 7). By seeing the idea in a new form, designers can spot problems and improve the design and how they understand the problem.



**Figure 7.** Examples of representation action: sketching to explore early ideas and using 3D visualization to evaluate scale, form, and functionality during concept development.

### 3. Reflective Action

Uncertainty also drives reflection, both shared and individual, and this reflection is key to refining understanding. It happens in conversations, like team discussions, critiques, or

stakeholder reviews, and also in quieter moments, when designers step back to think through their work on their own. Schön (1979) describes two kinds of reflection: "*reflection-in-action*," which happens during the design process, and "*reflection-on-action*," which happens after a design move. In practice, reflection during brainstorming sessions or peer reviews often brings up questions or ideas that hadn't been considered before. For example, during a prototype review, a compliance expert might raise concerns about a small part that could create a pinch hazard, something not yet caught by the design team. This kind of feedback prompts the team to revisit earlier decisions or adjust priorities. At Bugaboo, these reflective moments, whether sparked by a colleague, an expert, or an individual pause, are essential for combining different types of knowledge, seeing blind spots, and strengthening the overall design (Figure 8).



**Figure 8:** Examples of reflective action: designers engage in discussion to evaluate design decisions, interpret constraints, and assess the feasibility of next steps within the project context.

These three actions, information, representation, and reflection, rarely occur in isolation. Instead, they form a reinforcing loop: new information sparks reflection, which leads to new representations, which in turn raise new questions and information needs. This ongoing cycle is central to how design moves forward, especially under uncertainty.

Generative AI can play a meaningful role within this loop. While it cannot eliminate uncertainty, nor should it, it can help designers manage it more effectively. Rather than supporting a step-by-step process, AI is best suited to enhance the iterative, exploratory nature of design work:

- In contexts shaped by bounded rationality, generative AI can act as a cognitive amplifier, summarising regulations, extracting themes from research, or suggesting viable directions that meet time, cost, and feasibility constraints. In this way, it can support information action, helping teams frame problems more clearly.
- Through the lens of expandable rationality, generative AI also contributes to representation action by generating quick visual or structural variations based on sketches, prompts, or previous designs. These outputs can expand the concept space, stimulate divergence, and support proposing.

- AI can further aid reflective action by helping synthesize feedback, simulate trade-offs, or structure evaluation sessions. For example, it can organize stakeholder input or highlight conflicting constraints, guiding more informed design decisions.

Overall, generative AI can enhance the three key uncertainty-driven actions at the heart of design, supporting framing, proposing, and evaluating. Its value lies not in automation, but in amplifying human creativity in moments of ambiguity. This perspective lays the groundwork for the next section, which introduces the Frame–Propose–Evaluate (FPE) model, a simplified model of design that captures how these cycles play out in practice at Bugaboo and visualizes where AI could augment the process.

#### *4.5. Frame, Propose, Evaluate: A Simplified Model of Design*

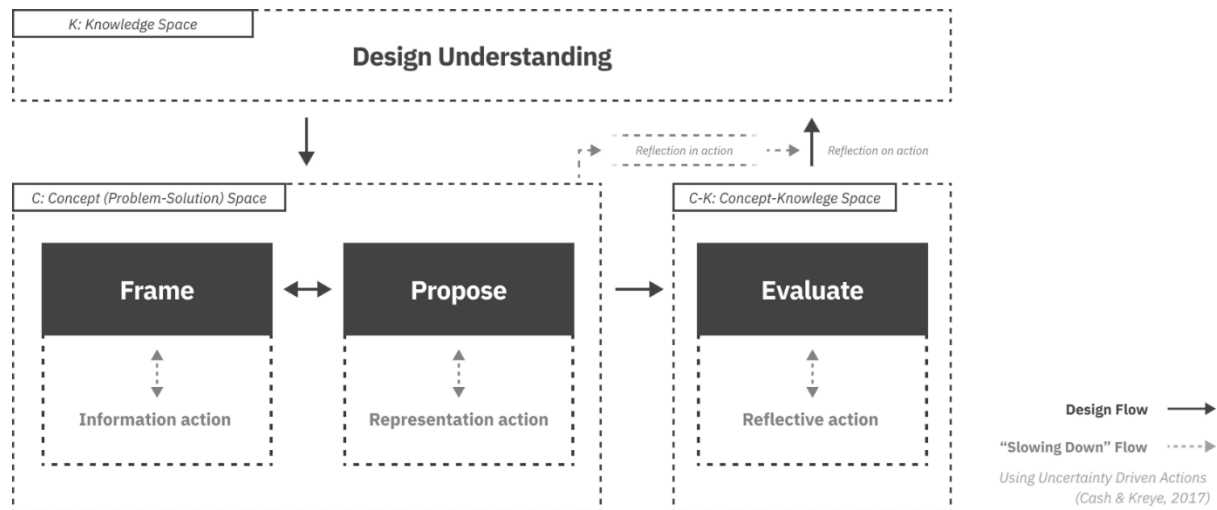
While established theories like bounded rationality (Simon, 1956), expandable rationality (Hatchuel, 2001), and the Uncertainty-Driven Action model (Cash & Kreye, 2017) richly describe the cognitive and systemic dynamics of design, they lacked a unified, observable structure that I could apply directly to empirical design situations. To address this need, I developed the Frame–Propose–Evaluate (FPE) simplified model of design (Figure 9). FPE is not a new theory. Instead, it acts as a practical lens for recognizing how design unfolds.

The model emerged both deductively, from theory, and inductively, through observing Bugaboo’s design teams in workshops, prototype reviews, and live problem-solving sessions. Across these contexts, I consistently observed design progressing through iterative, overlapping cycles of framing problems, proposing alternatives, and evaluating directions, moves often driven by uncertainty and supported by three core types of action identified by the UDA model: information, representation, and reflective action.

As such, the FPE model captures three core design moves: Frame, where teams (re-)define the problem space; Propose, where ideas are generated; and Evaluate, where these proposals are assessed.<sup>2</sup> Each of these is supported by distinct forms of uncertainty-driven action: information action in framing, representation action in proposing, and reflective action in evaluating. These actions slow the flow of design when clarity is low, creating space for teams to regain direction, generate insight, and sustain momentum. In this way, FPE serves both as a lens and as a practical scaffold for understanding where to introduce generative AI, which will be illustrated in the next section.

---

<sup>2</sup> which, in retrospect closely resembles Schön’s (1984) model of naming, framing, moving, and evaluating



**Figure 9.** The FPE model synthesizes theoretical insights with observations. It captures how design progresses through iterative cycles of framing, proposing, and evaluating. Each phase is supported by uncertainty-driven actions – information, representation, and reflective action (Cash & Kreye, 2017) – which help teams slow down, clarify direction, and respond to ambiguity in real-world design practice.

#### 4.5.1. FPE in Action: A Live Design Session at Bugaboo

To ground the Frame–Propose–Evaluate (FPE) simplified model of design in practice, I will illustrate a live collaborative design session I observed at Bugaboo, focused on developing a new backrest concept for a juvenile mobility product. It was selected because it showcased the kind of iterative, uncertain, and co-creative behavior that FPE seeks to explain. During the session, the designers had a live prototype of the stroller frame on hand (Figure 10), so designers could physically point to specific areas and clarify potential attachment methods. This real, tangible artifact became central to their collaborative process, exemplifying how representation action (in the FPE model) supports deeper discussion and sparks fresh ideas.



**Figure 10.** Designers explore a new backrest concept using a physical prototype. The tangible artifact supports quick cycles of framing, proposing, and evaluating, exemplifying how the FPE model unfolds in real-world collaborative design.

The session unfolded as a free-form brainstorm, where framing, proposing, and evaluating happened in quick succession, sometimes within a single sentence or gesture. These cycles revealed moments of uncertainty that prompted follow-up uncertainty-driven actions beyond the meeting itself: testing, prototyping, and revisiting material assumptions. The sections below reconstruct three distinct FPE cycles from the session transcript to show how real-time design work at Bugaboo embodies the model in action.

The significance of this session lies not only in the live FPE cycles observed, but in the slower uncertainty-driven actions that followed. It made clear that while live design discussions follow a rapid Frame–Propose–Evaluate rhythm, the deeper uncertainty reduction at Bugaboo occurs *after* sessions through deliberate information, representation, and reflective actions (Cash and Kreye, 2017). Recognizing this, and as argued in Section 4.6, the thesis deliberately chooses to focus AI augmentation not on live creative flow, which risks disruption, but on these slower, post-session actions where AI can add value without fracturing collaboration. Accordingly, InsightGPT (Chapter 7), CreAIte Flow (Chapter 8), and RulesGPT (Chapter 9) each target a specific uncertainty-driven action, aligning AI intervention with the tempos and needs of Bugaboo’s design practice.

#### *4.5.1.1. Context and Method: Exploring a Backrest Design Challenge*

The session took place during the early stages of a backrest design exploration and included several designers and engineers. The aim was to resolve questions around how to attach a mesh seat to a backrest structure while balancing ergonomic, structural, and manufacturing considerations.

Four designers of the Bugaboo team met to address an open-ended and multifaceted design challenge: effectively attaching a mesh backrest to the frame, ensuring alignment with harness requirements, load-bearing capacity, and ease of assembly. From the outset, it was evident to the designers that multiple intertwined considerations, such as material durability, safety compliance, and production efficiency, required careful articulation of the exact problem at hand.

The session was recorded, transcribed, and analyzed using the FPE model as a heuristic. Quotes and paraphrases are used to preserve the intent and tone of the original discussion. While the conversation was informal and non-linear, distinct cycles of framing, proposing, and evaluating were clearly present.

#### *4.5.1.2. Iteration in Motion: Three Real-Time FPE Cycles*

Three distinct FPE cycles that were observed during the session, each demonstrating how problem definitions evolved, ideas were generated, and evaluations prompted refinement or reframing, are shown below. Each cycle is reconstructed to show how designers moved through the FPE model in real time.



#### 4.5.1.2.1. Cycle 1 – Mesh Attachment: Framing the Real Issue

The session began with an open-ended question: *“How to attach a mesh [to the backrest]?”* This marked the beginning of framing, as the team sought to define the problem space they needed to address. Framing in design involves identifying what exactly needs to be solved, and here, the designers were clarifying the boundaries of the challenge.

However, the frame quickly shifted when one designer suggested that the issue might not be limited to the mesh itself, but could involve deeper integration with the harness system: *“But that is maybe already on the level that is more focused on the harness... maybe we should try to first go more connection, how to attach.”* This move exemplifies how framing is often dynamic, requiring teams to refine the problem definition as new aspects emerge.

Once the immediate frame was set, the team moved into proposing, generating tentative solutions based on their understanding. One idea involved using a flexible wire that could be *“squeezed together and popped behind,”* while another suggested adding small plastic or silicone details to the frame. Proposing here is clear: the designers were externalizing possible solutions in response to the reframed challenge, visualizing how these ideas could physically work with the prototype in front of them.

After several ideas were proposed, an early evaluation naturally emerged. One team member raised concerns about stability: *“I think you still need something to secure it... if there are forces... we need to experiment how easily will it [come loose].”* This moment reflects evaluation because the team critically assessed whether their tentative proposals would hold up under real-world conditions, questioning their viability and prompting reflection on whether the original framing was sufficient.

#### 4.5.1.2.2. Cycle 2 – Load Demands: Balancing Strength and Simplicity

Building on the first cycle, the team sharpened their framing further by recognizing a crucial constraint: the backrest would need to support a load of up to 30 kilograms. Statements like *“We still have this requirement of hanging 30 kilos behind... which is a lot”* illustrate a deepening of the problem frame. Framing, in this case, involved explicitly surfacing technical demands that would heavily influence solution development.

With this clarified frame, the designers re-entered proposing. Ideas shifted accordingly: one suggestion was to reinforce the structure with screws at the top and bottom of the frame, allowing it to better withstand heavy loads. Here again, proposing is evident as designers offered concrete, buildable modifications in response to the newly refined problem space.

Yet evaluation followed almost immediately. Concerns surfaced: *“adding screws might make the assembly too complicated.”* This evaluative move critically examined the practicality of the proposed solution, balancing competing goals: structural integrity versus ease of assembly. Evaluating in this case involved anticipating real-world trade-offs, beyond purely technical performance.



#### 4.5.1.2.3. Cycle 3 – Exploring the Unknown: Divergence Under Uncertainty

As the brainstorming continued, the team openly admitted, *“We are sort of looking in the dark for a solution... we need to find a way to approach this.”* This recognition initiated a new framing move, framing not around a single solution path but around a divergent exploration, keeping multiple possibilities open. So instead of narrowing down right away, they decided *“We should not limit ourselves in the idea generation...”* and began mapping out a wide range of possibilities.

They proposed sliding mechanisms, plastic strips, metal wires, and clip-in concepts, all while gesturing to different parts of the prototype’s frame, envisioning how each method might work. Here, proposing was not about refining a single concept but actively mapping multiple directions in C-space, illustrating how proposing can be expansive when uncertainty is high.

Evaluation emerged more tentatively in this cycle. To gauge these ideas, they agreed that further tests would be essential. *“Maybe we should do a simple shape... build scenarios from there... and see if it actually handles real loads,”* someone suggested, illustrating how the evaluation stage naturally leads back into reframing and hands-on exploration. By the end of the session, no single solution had emerged triumphant. Instead, they agreed to investigate multiple concepts offline, gather more material data, and create scaled-down prototypes for quick trials.

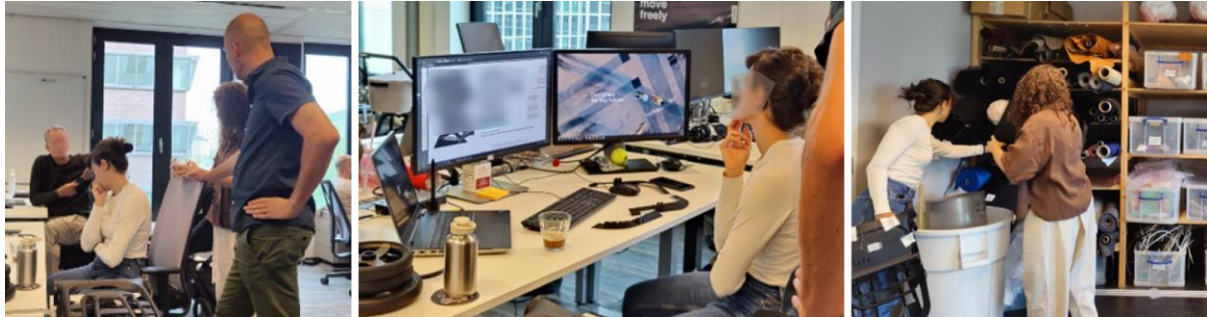
#### 4.5.1.2.4. Conclusion: Follow-Ups as Uncertainty-Driven Design Actions

Ultimately, the meeting concluded with a shared recognition that solving the mesh attachment challenge might extend well beyond a single design session. The group resolved to *“continue exploring directions”*, including building simpler test shapes to verify structural performance and refining their harness assumptions. They also planned to gather input on potential cost or manufacturing implications before reconvening. Specifically, the team agreed on distinct follow-up actions, including data gathering, prototyping, and user load testing. These follow-up actions, slower and methodical compared to the rapid, conversational exchanges during the session, constitute clear uncertainty-driven actions identified in the FPE model:

- **Information Action:** Designers planned explicitly to look into material availability.
- **Representation Action:** Participants committed to creating *“quick prototypes or simple shape models.”*
- **Reflective Action:** The team planned to gather broader feedback, including from colleagues and compliance experts, and to reflect on the requirements.

In the aftermath, several uncertainty-driven actions took shape. The designers arranged to reflect on the requirements, make models, and gather data on materials (Figure 11).

The session exemplified how framing, proposing, and evaluating repeat in quick succession, informed by the physical prototype, ongoing reflection, and real-world constraints, followed by uncertainty-driven actions. This process is at the core of Bugaboo's design culture, where progress often unfolds through loops of discussion, experimentation, and revision.



**Figure 11.** After the design session, team members engaged in a range of slower, deliberate follow-up activities—1) reflecting on requirements. 2) modelling, and 3) researching materials. These actions reflect the FPE model's core uncertainty-driven processes: information gathering, representation, and reflective action.

#### 4.6. Conclusion: Where AI Can Help — Augmenting FPE By Supporting Uncertainty Reduction Actions, Without Interrupting Flow

The tacit, high-velocity mode of working present at Bugaboo poses a unique challenge for the integration of external tools like generative AI. In moments of active designing, thinking, speaking, sketching, and critiquing are deeply entangled (Figure 12). If the flow of (collaborative) design were interrupted, say, to query a tool or interpret an AI output, it could risk disrupting the very process it aims to support. In this context, AI augmentation must be approached with care; if poorly timed or mismatched, it could slow or fracture the intuitive rhythm of design collaboration.

Gu et al. (2025), drawing on Redifer et al. (2019), warn that the effort required to interpret and verify AI outputs can increase designers' cognitive load, potentially hindering the creative flexibility essential for effective live collaboration. I have personally experienced this cognitive load during brainstorming at Bugaboo, where the pressure to both generate and critically assess ideas in real time has often disrupted the natural creative flow.



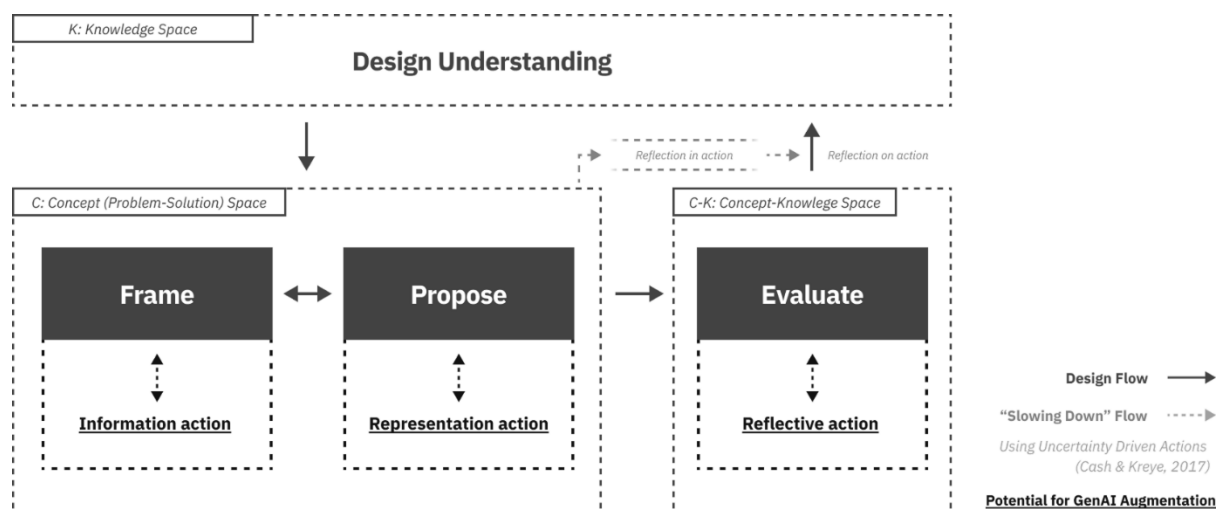
**Figure 12.** In live sessions like this one at Bugaboo, designers engage in high-velocity collaboration—gesturing, critiquing, and iterating in real time. Introducing AI tools during such moments risks disrupting this intuitive flow. Instead, AI is best positioned to support the uncertainty-driven actions that occur before and after live sessions.

Given this reality, this thesis does not focus on embedding AI into the fast-paced core of live design and ideation. Instead, it proposes that the most appropriate and impactful role for generative AI lies in augmenting the slower, uncertainty-driven actions that surround these rapid exchanges (information, representation, and reflective action). These include activities such as research before a session, the externalization of concepts through sketches or low-fidelity prototypes afterward, and the structured reflection that happens between iterations. It is within these quieter, more deliberate activities that AI can integrate most effectively, adding value without interrupting the creative flow.

The Frame–Propose–Evaluate (FPE) simplified model of design provides a clear lens to identify these augmentation opportunities (Figure 13):

- **In the Frame phase**, AI could support *information action* by enabling desk research, processing large volumes of research or simulating user feedback to uncover patterns, constraints, or overlooked factors, helping designers approach the problem-solution space with a more informed perspective (Chapter 7).
- **In the Propose phase**, generative AI could enhance *representation action* by rapidly producing visuals and variations of early concepts, stimulating exploration, and offering starting points for further iteration (Chapter 8).
- **In the Evaluate phase**, AI could assist *reflective action* by synthesizing or simulating disparate forms of feedback such as stakeholder input or compliance requirements into clear, actionable insights (Chapter 9).

By aligning AI augmentation with the uncertainty-driven rhythms captured in the FPE model, this foundation now sets the stage for identifying targeted, practical use cases where generative AI can meaningfully support Bugaboo’s design practice.



**Figure 13.** Building on the Frame–Propose–Evaluate (FPE) framework, this diagram highlights where generative AI can most effectively support design work: in the slower uncertainty-driven actions of information,, representation, and reflective action. These activities surrounding live design sessions offer integration points where AI can add value without disrupting creative flow. The model’s full description can be found in Appendix A.

## 5. Finding the Right Use Cases for AI at Bugaboo

### 5.1. Introduction: Pinpointing Where Generative AI Can Help

With the FPE framework established and a clearer understanding of how generative AI could meaningfully support design, this chapter moves from building the foundation to exploring practical possibilities. The goal is to identify where AI could genuinely help Bugaboo's design teams in their day-to-day work, not by forcing technology into the process, but by finding natural points where it can add value without disrupting the way designers already work.

To do this, I combined two sources of insight. First, I revisited the earlier literature review, this time looking specifically through the lens of the FPE model to understand where AI has shown promise in supporting different stages of design work. Second, I organized a workshop with Bugaboo's designers, asking them to reflect on their current practices, where they experience friction, and how they imagine AI could actually support them. The literature offered a broader perspective on what AI could do; the workshop grounded those possibilities in the real challenges, routines, and aspirations of Bugaboo's design teams.

From these two inputs, three high-potential directions for AI support emerged, each mapped to a stage of the FPE cycle: InsightGPT (supporting Frame), CreAIte (supporting Propose), and RulesGPT (supporting Evaluate). Each idea is intended not just to insert AI into the process, but to strengthen what designers already value: creative autonomy, hands-on exploration, and user impact, while easing the burdens that slow them down.

The next sections describe how I gathered these insights and shaped them into focused, actionable opportunities for AI at Bugaboo.

### 5.2. Method: Mapping AI Opportunities to Real Design Needs

The opportunity mapping started by working directly with Bugaboo's design team. I organized a 90-minute workshop with eight designers from different roles, experience levels, and product areas. Through open discussions, visual mapping exercises, and structured exercises, we explored where designers experience friction, what drives their creativity, and how they imagine AI could help in their work.

Rather than following a strict analytical process, the insights emerged naturally through conversation, group reflection, and shared examples. As designers talked through their daily challenges and hopes for better tools, patterns began to take shape, showing where AI could meaningfully support the flow of design activity without getting in the way.

These emerging insights were then compared against the earlier literature review, helping to connect the designers' real-world needs with broader possibilities for generative AI. In this way, the opportunity directions were not imposed from outside theory but grew directly

from Bugaboo's design practice, ensuring that any AI support would feel grounded, relevant, and genuinely helpful.

### 5.3. What Designers Need from AI: Insights from the Workshop

The opportunity workshop with Bugaboo's in-house design team offered rich insights into how generative AI could meaningfully support their work. What follows is a narrative synthesis of the core findings, organized around three themes: (1) what motivates designers in their current practice, (2) where friction and frustration arise, and (3) emerging ideas for AI integration.

#### 5.3.1. What Designers Love: Autonomy, Making, and Impact

Throughout the workshop, a strong and consistent theme emerged: Bugaboo designers are most energized when their work balances creative autonomy, hands-on making, and tangible user impact. These elements form the cultural foundation of the design team and are critical to how they experience fulfillment in their roles.

Autonomy was especially valued. Designers appreciated the freedom to explore, make decisions, and shape outcomes independently. This freedom was seen as crucial for personal investment and creative confidence. As one designer put it: *"There's not a lot of micromanaging around us... I feel that I'm responsible for what I do."*

The early stages of design, ideation, and prototyping were described as particularly rewarding. These phases, where ideas shift from abstract concepts into tangible forms, were seen as moments of energy, experimentation, and fast feedback. One designer captured this well: *"When there's a design idea... testing is when the idea comes to life."*

The excitement of beginning a new project also stood out. Designers described the blank canvas moment as both exhilarating and daunting, a space full of potential but also uncertainty. As one designer reflected: *"Starting with a blank sheet is nice, but also feels insecure."* Another captured the emotional highs of creation: *"I have two highs. The first high is when it's all blank, where we can start, and the sky's the limit... and then making models, which is my specialty."*

Ultimately, designers pointed to the emotional reward of seeing their work connect with users. Creating products that people love and trust was seen as the ultimate validation of their efforts. As one designer simply put it: *"Working on products that people really like."*

Taken together, these reflections highlight a deeply human-centered approach to design, grounded in curiosity, craftsmanship, and care for the user experience. Any introduction of generative AI into this context must protect what designers already value: preserving autonomy, accelerating early exploration, and strengthening the connection between ideas and user needs, not getting in the way.

### 5.3.2. What Gets in the Way: Friction Points in Daily Design Work

While many aspects of design at Bugaboo were described as deeply fulfilling, the workshop also surfaced persistent friction points that sap creative energy and slow momentum.

These challenges fell into five main categories: administrative overload, decision-making delays, creative fixation, prototyping barriers, and regulatory burdens.

Administrative work, such as documentation, planning, and regulatory checks, was seen as necessary but draining. Designers expressed frustration at how much time these tasks consumed, often pulling them away from more creative activities. As one designer put it: *“Planning... I need it, but I don’t enjoy doing this.”* The issue was not the tasks themselves, but their intrusion into time meant for design work.

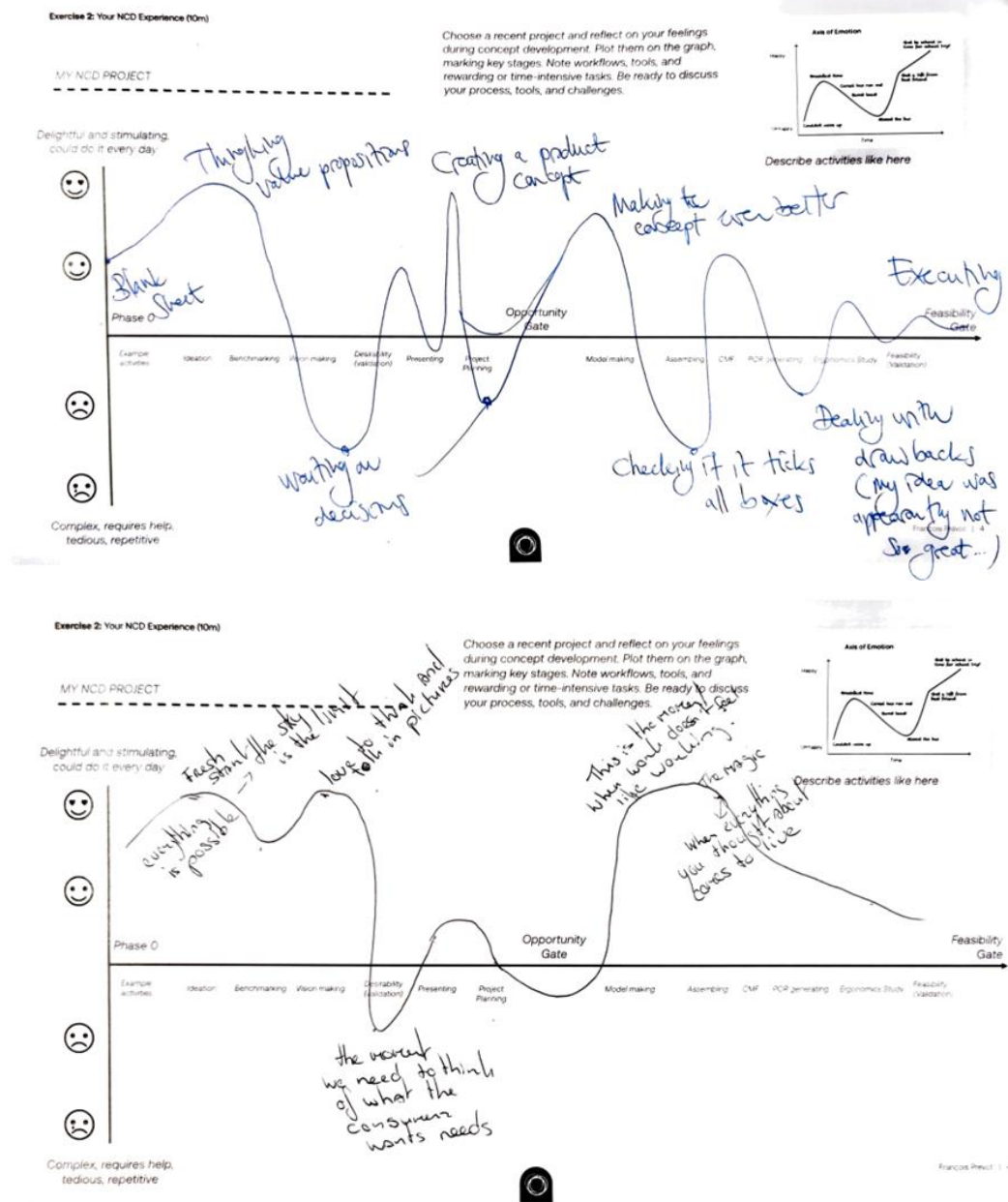
Delays in decision-making were another major source of frustration. Designers described long periods of waiting for approvals or team alignment, particularly in the early stages of projects when momentum is most fragile. As one designer said plainly: *“It takes ages before we make a decision on what to do... that’s really like waiting on decisions. That’s a low.”* These pauses didn’t just waste time; they drained creative energy.

A third challenge was creative fixation, the tendency to latch onto initial ideas and struggle to move beyond them. Designers acknowledged that early concepts often became psychological anchors, even when better alternatives might exist. One designer reflected: *“AI can save the concept from my own ideation because I often immediately get a solution, and then I get married to it.”* Designers expressed a need for tools that help keep the ideation process open longer, encouraging broader exploration before converging.

Barriers in prototyping and visualization also emerged. Some designers described frustration when they couldn’t easily externalize their ideas, particularly those less comfortable with 3D modeling tools. One designer shared: *“I just get annoyed when I cannot make the stuff that I was imagining.”* Another added: *“The 3D part... I hate it. I always hate it.”* These barriers weren’t just technical; they slowed the creative feedback loop that designers rely on.

Finally, dealing with compliance and regulatory checks was cited as a major drain. Although designers understood the necessity of these processes, they described them as time-consuming, opaque, and sometimes demoralizing. One designer captured the feeling bluntly: *“All this checking and dealing with regulations... It’s frustrating.”* Another described the emotional toll of discovering late-stage compliance issues: *“Dealing with drawbacks and finding out that your idea apparently was not so great.”*

Taken together, these insights point to a recurring tension: the desire for fluid, exploratory design versus the practical realities of operating within a complex, heavily regulated product environment. They also point directly to opportunity areas for generative AI: simplifying administrative tasks, speeding up decisions, supporting creative divergence, accelerating prototyping, and easing the regulatory burden (Figure 14).



**Figure 14.** These are two curves from the workshop that illustrate the emotional journey of designers as they move through the phases of concept development. Highs often occur during open exploration and early prototyping — “like the sky is the limit,” “love to talk in pictures,” “thinking through the value proposition.” Lows appear during moments of uncertainty, when decisions need to be made, when ideas are tested, assumptions are challenged, or external criteria must be met “the moment we really need to think of what the consumer needs,” “waiting on decisions,” “checking if it ticks all the boxes,” “dealing with drawbacks (my idea was not so great).”

These patterns highlight where generative AI could meaningfully support design: by enhancing the energizing phases of open exploration and early concept expression, while easing the effortful tasks that follow, such as gathering relevant information, formalizing designs against requirements, and critically evaluating concepts.

### 5.3.3. What If: Designers' Ideas for AI That Actually Help

In the final stage of the workshop, designers were asked to move beyond current frustrations and imagine how generative AI could constructively support or even transform their design practice. The ideas they proposed were diverse, practical, and forward-looking, ranging from task automation to more speculative visions of AI as a creative sparring partner. Together, these ideas reveal a clear understanding of both the constraints of current workflows and the potential of AI to enable more fluid design activity.

The ideas clustered around several opportunity areas, which are summarized in Table 1.

**Table 1.** Summary of AI opportunity areas as identified through the Bugaboo design team workshop, mapped against core creative tensions and design needs discussed in Section 5.3.3. Each area reflects how designers imagine AI could meaningfully support early-stage design without disrupting autonomy, creativity, or user empathy. All underlying quotes, idea sheets, and thematic mappings are included in full in Appendix B.

Opportunity Area	Design-Centered Need	Illustrative Use Case
<b>1. Automate the Pain</b> <i>AI to protect creative time by absorbing necessary but non-creative work.</i>	Designers want to stay focused on making and iterating, not on tracking hours, formatting documents, or manually checking compliance. The goal is to keep flow uninterrupted.	AI pre-checks design mockups for compliance, completes FMEA charts, registers hours based on calendars, and summarizes stakeholder feedback or meeting notes.
<b>2. Boost the Spark</b> <i>AI to expand the imagination space, not limit it.</i>	Designers struggle with fixation and wish for tools that help keep the ideation phase open and alive. They seek frictionless ways to explore alternatives without losing authorship.	AI offers diverse interpretations of rough sketches, generates surprising but relevant alternatives, and facilitates iterative dialogues that push the concept further before narrowing.
<b>3. Know the User</b> <i>AI to bring real users closer into every step, even early on.</i>	Designers value empathy and real-world connection, but often lack live user feedback early in the process. They need grounded insight that feels alive, not abstract.	AI synthesizes user feedback across channels, simulates persona conversations, and generates emotionally resonant user stories based on live patterns and global trends.

In discussion with the team, the following directions were identified as the most promising for AI integration in Bugaboo's design process:

#### 5.3.3.1 Automate the Pain: AI for Regulation Checks

A clear need emerged to offload repetitive administrative and technical duties, particularly those related to regulatory compliance. Designers expressed the hope that AI could handle these checks automatically, allowing them to focus more on creative and strategic tasks. One designer envisioned: *"If I make a prototype or mockup, the AI scans it and resolves all regulatory issues; if not solved physically, it suggests wording or loopholes."*

This aspiration highlights a desire for AI tools that not only detect compliance gaps but also offer actionable solutions, helping maintain momentum without being bogged down by procedural bottlenecks.



#### 5.3.3.2. Boost the Spark: AI for Creative Expansion

Designers strongly expressed the need for AI tools that could actively support and expand creative processes. Challenges such as creative fixation, generating diverse alternatives, and slow visualization cycles were recurring frustrations. AI was imagined as a catalyst for ideation, capable of quickly translating sketches into visual outputs, proposing unconventional alternatives, and providing real-time feasibility feedback.

One designer emphasized the need to *“open up my imagination, save me from fixation.”* Another described a vision for an iterative AI partner: *“Have an iterative conversation on conceiving. Speed up the process while enhancing quality through a wider solution space.”*

There was particular interest in visual diversity: AI that could generate quick variations of materials, patterns, or colorways. As one participant said, *“Create new patterns for fabrics or prints. Create quick color variations of a design.”* Designers also saw potential for AI to bridge sketching and technical execution, imagining tools that could *“convert sketches to 3D with realistic outputs and handle design adjustments based on input.”*

Importantly, designers also envisioned AI helping to refine and polish creative outputs. One suggested: *“Ask AI if my work is true to Bugaboo’s design and help solve styling, usage, or characteristic issues.”* Another proposed an AI that could beautify rough sketches quickly: *“Make sketch beautiful. Short sketching rough > beautify + variations.”*

These ideas reflect a broader desire to use AI to keep creativity moving, accelerate idea generation, expand the solution space, and support designers in expressing and refining their ideas more fluently.

#### 5.3.3.3. Know the User: AI for Continuous Insight

Designers also saw strong potential for AI to enhance user research and insight generation. They imagined AI systems that could help with desk research by gathering and synthesizing user feedback and simulating interactions, providing a real-time, dynamic understanding of users and markets.

One designer imagined: *“Generate a user in VR that you can talk to, ask questions, and interact with personas representing users.”* Another suggested using AI to maintain a continuous flow of user feedback: *“A chatbot replaces user panels for constant interaction with the average user persona of different countries.”*

There was also a call for AI to make sense of the flood of customer feedback across digital channels: *“Bring info about customer feedback. Collect and categorize info from digital channels about what users like, don’t like, and what they need.”*

Additionally, designers saw storytelling as an important part of deepening user empathy. Some suggested tools that could help frame user narratives more powerfully or generate explanatory text describing the inspiration behind a design. As one designer envisioned:

*“Write text explaining the inspiration source. Type keywords and let the AI generate explanatory text.”*

Collectively, these ideas show a strong ambition to use AI as a bridge between design and user understanding, helping designers maintain a close connection to user needs, behaviors, and stories throughout the process.

## 5.4. From Insights to Concepts: Where AI Can Add the Most Value

The insights gathered from both the literature review and the internal design workshop converged through an iterative and reflective synthesis process. Rather than imposing strict, pre-defined categories, I engaged in a dynamic dialogue with the design team and stakeholders, interpreting findings through the lens of the Frame–Propose–Evaluate (FPE) framework. The resulting opportunity landscape is summarized in Table 2.

**Table 2.** This table synthesizes insights from literature and the Bugaboo workshop, identifying points of alignment across the Frame–Propose–Evaluate (FPE) model. It highlights where generative AI can offer the greatest value by supporting uncertainty-driven actions: informing early framing through synthesis, expanding creative exploration, and easing the burden of evaluation and compliance.

FPE Phase	Literature Insights	Workshop Insights	Overlap & Opportunity
<b>Frame (Information Action)</b>	AI can synthesize large datasets: user sentiment analysis, persona generation, and trend monitoring.	Designers seek faster desk research methods to access user insights, market trends, and real-time persona development.	Strong demand for AI-powered synthesis to inform framing and decision-making.
<b>Propose (Representation Action)</b>	Generative AI can support idea generation, creative divergence, fast visualization, and prototyping.	Designers seek help breaking fixation, creating alternatives, and speeding up visualization.	Shared emphasis on expanding the creative search space and accelerating iteration.
<b>Evaluate (Reflective Action)</b>	AI can assist in checking design alternatives, parsing compliance, and optimizing decision-making.	Designers want regulatory support and early detection of potential risks.	Clear convergence on offloading regulatory overhead and speeding up decision cycles.

This triangulation highlights that all three phases of design, from framing the problem to evaluating potential solutions, contain actionable, high-impact entry points for generative AI. Importantly, these are not abstract or speculative domains. They reflect *pragmatic gaps* in current workflows that AI tools could address without compromising the creative integrity of the design process.

### 5.4.1. Three Tool Directions Mapped to FPE

The integration of the literature scan and the workshop culminated in three clear directions for generative AI support across the Frame–Propose–Evaluate (FPE) framework. Each

direction addresses a phase-specific pain point, one that has consistently surfaced with Bugaboo designers and is supported by recent literature. These targeted concepts are not generic tools but scenario-specific responses to the realities of design at Bugaboo.

#### 5.4.1.1. InsightGPT: Smarter User Research (Frame)

In the Frame phase, designers consistently expressed a need for faster, more fluid ways to access evolving user insights when performing information action. Traditional research cycles, while valued, were often too slow or static to support rapid early-stage exploration. One designer imagined a future tool where *“a chatbot replaces user panels for constant interaction with the average user persona of different countries.”*

This inspired the idea of a system like InsightGPT: an AI-powered research assistant that could create evolving personas, simulate user conversations, and surface emerging behaviors in real time. Another designer suggested the need to *“bring info about customer feedback, collect and categorize info from digital channels about what users like, don’t like, and what they need,”* hinting at the demand for continuous, synthesized user understanding. Others pushed the idea further, envisioning more immersive approaches. One designer proposed: *“Generate a user in VR that you can talk to, ask questions, and interact with personas representing users.”*

The common thread across these ideas was clear: in early framing, designers want to interact dynamically with user perspectives, not be constrained by static assumptions. InsightGPT would aim to support this need, providing an evolving research surface that enriches framing without replacing human interpretation.

#### 5.4.1.2. CreAIte: Fast Visual Exploration (Propose)

In the Propose phase, the need to support representation action, expand idea generation, and move beyond creative fixation emerged as a recurring theme. Designers described how initial concepts often anchored thinking too early, limiting exploration. One designer captured this tension, saying: *“Open up my imagination, save me from fixation.”*

This sparked the idea of CreAIte: an AI-driven ideation support that could transform early sketches or loose prompts into multiple visual pathways, offering quick variations in styles, structures, materials, or finishes to keep creative momentum high. Another designer imagined *“an iterative conversation on conceiving, speeding up the process while enhancing quality through a wider solution space.”*

The aspiration was not just speed, but breadth. Designers wanted to see unexpected alternatives, to stretch visual thinking before committing to a path. Some suggested richer visual outputs as well: *“Create new patterns for fabrics or prints. Create quick color variations of a design.”* Others extended this need toward early execution: one designer envisioned a tool that could *“convert sketches to 3D with realistic outputs and handle design adjustments based on input.”*

Across these ideas, CreAIte would not replace traditional sketching or CAD; it would act as an early-stage visual amplifier, helping designers stay divergent longer, explore more broadly, and evolve ideas faster.

#### 5.4.1.3. RulesGPT: Real-Time Compliance Support (Evaluate)

In the Evaluate phase, designers consistently highlighted how regulatory checks and compliance work burdened the creative process. Although necessary, these activities were often experienced as disruptive, arriving too late and causing frustration. As one designer put it: *“All this checking and dealing with regulations... It’s frustrating.”*

This inspired the idea of RulesGPT: a lightweight AI assistant embedded into the design workflow to help designers find, interpret, and reflect on regulatory and compliance requirements faster in the process. Instead of functioning as a rigid end-stage check, RulesGPT would support designers in actively querying standards, flagging potential risks, and exploring alternative solutions while ideas are still flexible. One designer envisioned this kind of support: *“If I make a prototype or mockup, the AI scans it and resolves all regulatory issues; if not solved physically, it suggests wording or loopholes.”*

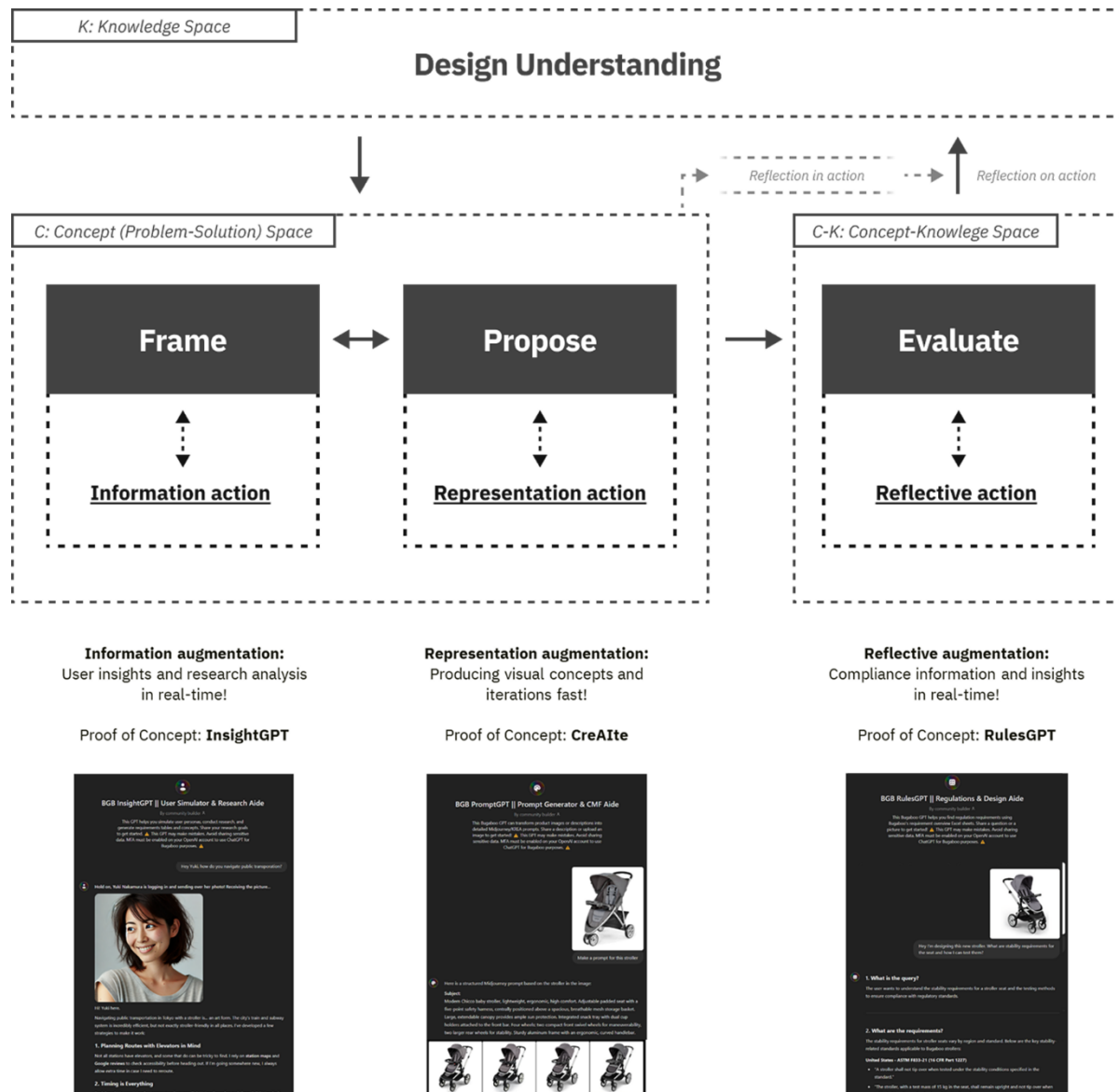
In this way, RulesGPT would strengthen reflective action, not by replacing compliance experts, but by giving designers early tools to identify key requirements, understand constraints, and engage more productively with expert feedback.

### 5.5. Conclusion: Mapping the Way for AI in Design

This chapter identified actionable opportunities for generative AI integration within Bugaboo’s design process by combining insights from literature and internal practitioner perspectives. The workshop made it clear that Bugaboo’s designers value autonomy, hands-on making, and the emotional connection to users above all. At the same time, persistent friction points, such as waiting for decisions, creative fixation, prototyping barriers, and compliance demands, reveal spaces where carefully designed AI tools could genuinely help without compromising what makes design meaningful.

By placing these needs within the Frame–Propose–Evaluate (FPE) model, the opportunity mapping became more concrete, highlighting clear points where AI could meaningfully support design without disrupting it. AI could enhance information action during framing by making user insights more dynamic and accessible (InsightGPT – Chapter 7); assist representation action during proposing by expanding visual exploration and accelerating iteration (CreAIte – Chapter 8); and strengthen reflective action during evaluation by helping designers find, interpret, and act on compliance requirements faster and more confidently (RulesGPT – Chapter 9), as seen in Figure 15.

With these opportunity directions defined, the next phase of this thesis turns toward translating them into concrete AI concepts that could be prototyped, tested, and refined within Bugaboo’s real-world design environment.



**Figure 15** Key AI opportunities identified through the workshop are positioned within the Frame–Propose–Evaluate (FPE) model, illustrating how InsightGPT, CreAiTe, and RulesGPT can support framing, proposing, and evaluating in design. These directions set the stage for prototyping and testing in the following chapters.

## PHASE 2: Building, Intervention, and Evaluation

*The second phase of this thesis picks up directly from the first: having identified three high-potential opportunities for generative AI, the focus now shifts from speculative mapping to practical, situated experimentation. Phase 2 moves from theory into action, embedding prototypes into the real, messy rhythms of design at Bugaboo.*

*Chapter 6 outlines the methodological approach, which deliberately blurs the line between design and evaluation. Rather than treating them as separate stages, every tool iteration is immediately exposed to day-to-day development, and every piece of feedback loops directly into the next version. Intervention and reflection unfold side-by-side, allowing the research to stay grounded in lived practice rather than controlled experimentation.*

*Chapters 7, 8, and 9 follow the journey of each tool across this build–test–refine cycle:*

**InsightGPT** augments the Frame move by synthesising fragmented research into living, dialogue-ready personas. The chapter shows the tool's power, fast empathy building, on-demand framing hypotheses, and its limits: prompt-dependency, occasional generic drift, and the need for human triangulation. A Technology-Acceptance (TAM) survey records cautious enthusiasm: AI is great for opening the problem space, but it is no substitute for real parents and real strollers.

**CreAIt**e connects PromptGPT, KREA, and Midjourney, and lets teams explore the visual search space through many variants in minutes. Used on stroller and accessory styling, it accelerates divergence and enriches reflection. Yet the very abundance of images breeds decision fatigue; structural fidelity, logo integrity, and fine color, material, and finish (CMF) details still require traditional CAD and designer judgment. Again, TAM scores are high on inspiration and lower on late-stage precision.

**RulesGPT** tackles the pain of compliance by retrieving verbatim clauses, test methods, and human-readable summaries on demand. Early sessions cut hours of SharePoint digging and e-mail ping-pong, but also expose AI overconfidence and version muddles. Tightening the prompt grammar, forcing verbatim citations, and teaching the model to say “I don't know” restore trust. Designers now run quick checks themselves, reserving deeper legal review for edge cases, as reflected in the highest TAM score.

Finally, Chapter 10 zooms back out to reflect on the broader lessons learned from Phase 2. Generative AI excels at widening the design space and provoking ideas, but it cannot decide or converge; those tasks remain fundamentally human. Designers must develop prompt literacy, critical filtering, and convergence skills, while the organization must align AI use with strategy, ensure clean and accessible data, and foster a culture that treats AI as a creative partner, not a substitute. These lessons are captured in ten design principles and a phased roadmap for scaling AI across Bugaboo. Ultimately, where Phase 1 explored where AI could help, Phase 2 demonstrated how, by integrating tools into everyday design work.

## 6. Phase 2 Approach: Development of Generative AI Tools via Action Design Research

### 6.1. *The Cycle: Building, Intervention, and Evaluation*

In this second stage of the Action Design Research (ADR) process, *Building, Intervention, and Evaluation (BIE)*, the generative AI tools conceived in Phase 1 moved from concept to tangible use. Instead of building tools in isolation and evaluating them later, prototypes were immediately introduced into real design work at Bugaboo. As designers used the tools in live projects, feedback surfaced naturally and guided continuous refinement. Building, intervention, and evaluation became a single, ongoing cycle.

Three principles from Action Design Research (Sein et al., 2011) were especially important in shaping this process. Reciprocal shaping emphasized that both the tools and the design environment would evolve together through use. For instance, when designers began using InsightGPT, it quickly became clear that how they framed their prompts greatly affected the relevance of the outputs: generic questions produced generic results, while more specific prompts triggered sharper, more actionable insights. This not only led to technical refinements but also encouraged designers to rethink how they formulated research questions more broadly.

Mutually influential roles ensured that the development of the tools remained collaborative rather than top-down, with designers bringing domain expertise from daily practice, and I contributing methodological and technical guidance; this partnership helped the tools integrate naturally into Bugaboo's workflows without disrupting them.

Finally, authentic and concurrent evaluation meant that prototypes were assessed as they were used, not through isolated testing. Designers worked with the tools during real activities with feedback gathered through observations, reflections, and ongoing adjustments. Over time, this continuous cycle of adaptation strengthened the relationship between designers and tools, making the prototypes more useful while also building designers' confidence in shaping how AI could support their creative processes.

### 6.2. *Reflection and Learning: How Designers and Tools Evolved Together*

Learning in this research unfolded as a continuous, embedded process. Following the principle of guided emergence (Sein et al., 2011), prototypes and designer practices evolved together through live use, not in separate stages. Each interaction surfaced new limitations and possibilities, prompting adjustments rather than planned interventions.

When InsightGPT's early outputs proved too verbose and generic, reflection during use led to prompt refinements that made it a sharper, more responsive research companion. CreAIte initially overwhelmed designers with excessive visual outputs, but reflection

sessions quickly introduced guardrails, limiting divergence rounds and sharpening prompts, to keep exploration purposeful. Similarly, RulesGPT faced early trust issues when compliance answers varied; only through live feedback was traceability enforced, restoring confidence.

Across all three tools, short in-session and post-use debriefs became the engine of learning. Rather than treating evaluation as an endpoint, tool development and designer learning became inseparable, each iteration leaving both a little better fitted to the realities of creative, uncertainty-driven design.

### *6.3. Formalization of Learning: What This Teaches Us About AI in Design*

In the final stage of the ADR process, the focus shifted from tool-specific adjustments to a broader formalization of what had been learned across all interventions. Following the principle of generalized outcomes (Sein et al., 2011), I collected insights from ongoing field notes, TAM feedback, and post-session reflections, identifying patterns that cut across InsightGPT, CreAIte, and RulesGPT.

The formalization was not a single event but an iterative process that ran in parallel to tool development. After each session, reflection occurred, and emerging themes were discussed with participating designers. Particular attention was paid to lessons that appeared repeatedly across tools and sessions, rather than isolated observations.

As these discussions unfolded, it became clear that a set of consistent principles was beginning to emerge: about how generative AI needed to be framed within design practice, about the new skills designers needed to use it effectively, and about the types of support that made AI outputs truly usable in live projects.

Crucially, in parallel to these reflections, the Bugaboo team began raising forward-looking questions: seeing the early value of the prototypes, how could these tools be scaled thoughtfully across more teams and projects? From these conversations, the need for a structured adoption roadmap surfaced naturally, complementing the emerging design principles.

Thus, formalization in this project was not just about summarizing findings after the fact. It was built into the process from the start: a continuous effort to recognize generalizable patterns, to test their stability across different contexts, and to prepare the groundwork for scaling AI integration beyond the immediate pilot projects.

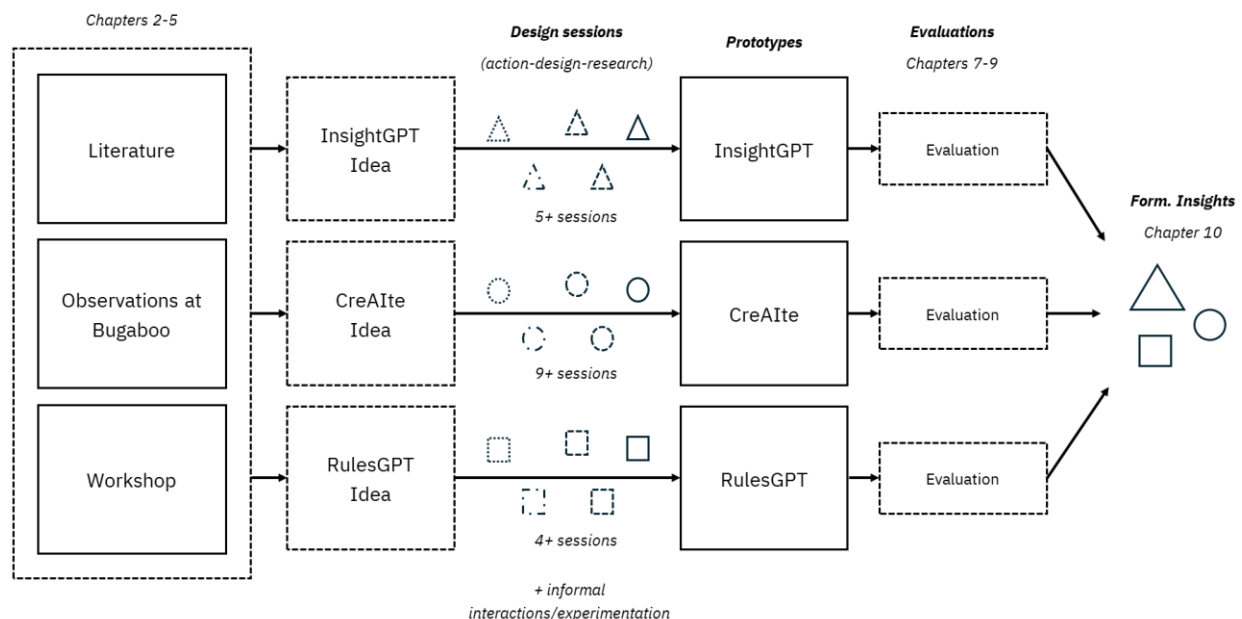
### *6.4. Data Collection Approach*

Throughout Phase 2, a core group of ten participants from Bugaboo's product development organization took part directly in structured build–intervention–evaluation cycles. They represented a broad range of roles, including product designers, pattern specialists, user researchers, innovation leads, and interns. Beyond this group, the broader initiative



involved two full product development teams, totalling over 25 people, including management and IT security members.

Formally, 16 structured research sessions and three reflection sessions were conducted across the prototypes InsightGPT, CreAIte, and RulesGPT. Each session lasted approximately one hour and was embedded within real design projects, avoiding controlled simulations. The open-ended, one-on-one format preserved contextual realism and enabled participants to act as active co-creators rather than passive testers (Figure 16).



**Figure 16.** Three generative AI tools, InsightGPT, CreAIte, and RulesGPT, were developed and refined through iterative design sessions, live prototyping, and in-situ evaluation at Bugaboo. This Build–Intervention–Evaluation cycle enabled tools and practices to co-evolve, leading to formalized insights in Chapter 10

Data collection combined field notes, AI-generated outputs, and debriefs to capture insights on tool performance, usability, and workflow fit.

Beyond the formal sessions, the three-month tool testing period involved continuous informal engagement. Designers discussed prompt strategies, adapted AI outputs into live projects, raised concerns, and contributed to ongoing refinements. As a researcher embedded at Bugaboo, I also gained real-time insights through these interactions, which influenced immediate tool adjustments and shaped the development process.

These day-to-day interactions, alongside the formal sessions, proved critical not only in gaining insights and strengthening the tools but also in informing the formulation of a structured roadmap for scaling generative AI across Bugaboo’s design practice.

## 7. AI for Framing: Exploring the Potential of InsightGPT to Augment Information Action

### 7.1. Introduction: InsightGPT and Early-Stage Framing at Bugaboo

This chapter examines the development, application, and evaluation of InsightGPT, a custom generative AI tool integrated into Bugaboo's early-stage design and user research workflows to augment information action during framing.

Early-stage framing is a critical but complex phase in product development, requiring rapid exploration of user needs, cultural nuances, and emerging opportunities, often before formal research can be deployed. At Bugaboo, this stage offers a valuable opportunity: to shape assumptions, explore alternatives, and ground innovation early. However, accessing timely, nuanced insights has traditionally been constrained by the slower pace of formal research and the static nature of persona libraries.

InsightGPT was conceived to address this opportunity. Developed as a tailored version of ChatGPT aligned to Bugaboo's segmentation models and exploratory workflows, it was designed not to replace traditional research but to complement it. InsightGPT enables dynamic persona generation, real-time scenario exploration, and accelerated desk research synthesis. By embedding these actions into daily practice, it aims to enable a continuous, on-demand inquiry model aligned with the fluid realities of design.

Through research sessions with three Bugaboo designers, spanning roles from innovation leads to interns, InsightGPT was tested across varied contexts, including persona development, brand positioning, exploratory ideation, and cross-cultural insight generation. Complementary benchmarking exercises compared AI outputs with empirical survey data, assessing where InsightGPT aligned with or diverged from traditional research.

Findings showed clear gains. Designers quickly accessed synthesized insights, created richly segmented, visually supported personas, and deepened empathy through interactive, scenario-based dialogue. InsightGPT enabled more dynamic framing, helping teams iteratively refine questions. Challenges emerged: its effectiveness hinged on prompt quality, and outputs could be verbose, generic, or misaligned with real data. InsightGPT remained reactive, underscoring the need for human oversight. These insights position it not as a replacement for research but as a provocation engine, one that accelerates early inquiry, broadens exploration, and embeds ongoing user reflection in design practice.

The sections that follow outline these findings. Section 7.2 describes the research participants and session contexts; Section 7.3 introduces InsightGPT's capabilities; Section 7.4 explores interface and development decisions; Section 7.5 reflects on learnings from early-stage research use; and Section 7.6 presents a Technology Acceptance Model (TAM) assessment, concluding with Section 7.7.

## 7.2. Participants and Research Sessions

Three Bugaboo designers participated in InsightGPT research sessions, each applying the tool in different contexts of early-stage design and user research.

- **Olivia**, a Product Innovation Lead with over a decade of experience at Bugaboo, used InsightGPT in one session to question synthetic personas for a stroller concept tailored to urban parents. She used InsightGPT's ability to identify culturally specific needs and behaviors.
- **Rohan**, Design Intern, participated in two sessions focused on synthesizing insights and refining personas for Scandinavian parents, with a focus on stroller lighting needs in low-light environments. He also took part in a joint reflection with Elisabeth.
- **Elisabeth**, User Researcher with over six years of experience at Bugaboo, explored how InsightGPT could support persona generation for branding and positioning in one session. She focused on using AI to craft narratives aligned with market segments and shared a reflection session with Rohan to compare their perspectives.

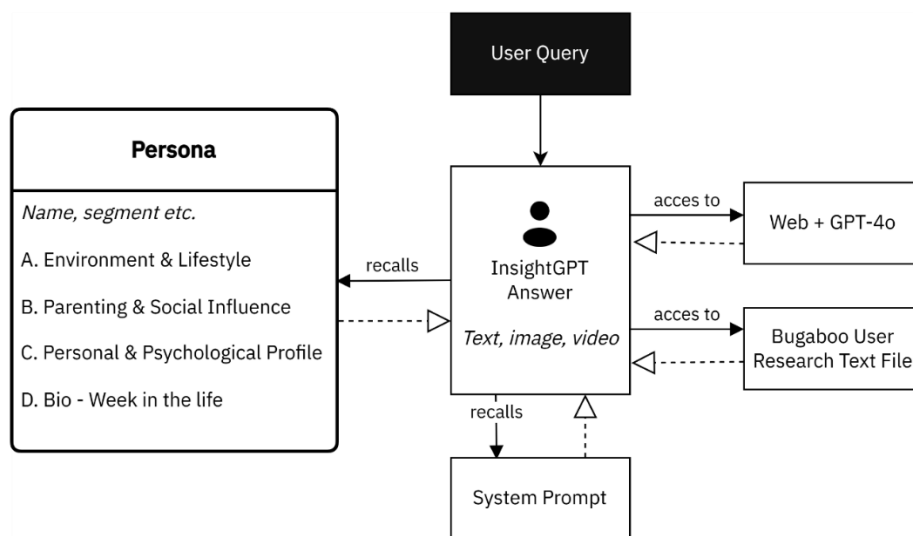
In addition to these designer-led sessions, I conducted two solo benchmarking exercises under Elisabeth's supervision. The first compared AI-generated insights with actual survey data to assess alignment and divergence. The second examined how AI-derived urban design recommendations overlapped with manually gathered research insights.

*For confidentiality reasons, the detailed session contents and outcomes have been omitted, and the names have been replaced with pseudonyms.*

## 7.3 Study Material: How InsightGPT Works and What It Offers

InsightGPT was developed as a custom instance of ChatGPT tailored to Bugaboo's design research needs. Unlike static persona templates or traditional survey methods, it enables real-time, adaptive engagement with AI-generated user profiles, supporting early-stage exploration, hypothesis testing, and desk research. The tool combines structured persona creation, simulated interviews, and accelerated desk research. It is designed to align with Bugaboo's internal segmentation models, ensuring that AI-generated insights are consistent with established brand frameworks and user segmentation.

As shown in Figure 17, InsightGPT operates by integrating a user query with a system prompt, Bugaboo's internal research files, and web-based information. It then generates multi-modal responses (text, image, or video) grounded in a dynamic persona profile enriched by contextual memory. This allows designers to engage in meaningful, scenario-based conversations and quickly surface relevant insights.



**Figure 17** This diagram shows how InsightGPT, powered by GPT-4o (ChatGPT’s large language model), answers designer questions by combining multiple sources: an AI-generated persona, Bugaboo’s internal user research, a tailored system prompt, and access to web data. The system uses these inputs to generate rich responses—text, image, or video—enabling designers to engage in adaptive first-person dialogues and conduct desk research.

### 7.3.1. InsightGPT Use-Cases: From Persona Creation to Integrated Desk Research

InsightGPT’s capabilities were designed to leverage ChatGPT’s inherent generative and conversational strengths, enabling designers to move seamlessly from persona creation to live research. The following describes what InsightGPT can do and how designers use it in practice, based on functionality demonstrated during testing (with performance varying depending on context and prompting):

#### 1. Adaptive Persona Development and Generation

Designers begin by defining target attributes (e.g., region, segment, product scenario). InsightGPT generates detailed personas with demographic, behavioral, and psychographic depth, aligned with Bugaboo’s segmentation logic, and enhances realism with an AI-generated photo.

#### 2. First-Person Persona Simulation and Dialogue

Once generated, personas can be interviewed in real time. Designers ask open-ended questions, and InsightGPT responds in a coherent, first-person voice, adjusting answers based on context and prior dialogue.

#### 3. Desk Research and Insight Generation

Designers can switch seamlessly between persona interaction and broader research queries, allowing for integrated exploration that blends empathy-driven insight with research synthesis.

#### 4. **Brand Alignment**

The tool references internal segmentation documentation, ensuring consistency in tone, priorities, and consumer representation.

#### 5. **Multi-Modal Outputs**

As illustrated in Figure 18, InsightGPT enhances engagement through images, quotes, and localized scenarios. The collage captures a simulated dialogue with “Ayaka,” a Japanese mom persona, including her AI-generated image and firsthand reflections on navigating Tokyo transit with a stroller, highlighting how design research can be enriched with realistic, context-sensitive outputs.

#### *7.3.2. Behind the Scenes: The Persona Creation Protocol*

InsightGPT follows a structured protocol when generating and embodying user personas. The process begins with persona generation, where InsightGPT creates detailed profiles including name, age, location, profession, Bugaboo segment classification, distinguishing characteristics, and a locally relevant quote. Each persona is enriched with tailored traits across three dimensions: environment and lifestyle, parenting and social influence, and personal and psychological profile, embedding segmentation logic and local references throughout. A short biographical narrative, describing a week in the life of the persona, further grounds the profile in realistic regional insights. To enhance engagement, a realistic, AI-generated image, adapted to local context, accompanies each persona.

Following generation, InsightGPT transitions to persona embodiment. The system adopts the persona’s identity, enabling designers to interact with it through a live research dialogue. AI responses are dynamically generated in a consistent first-person perspective, maintaining alignment with the persona’s environment, experiences, and psychographics.

Throughout this process, InsightGPT uses context memory to retain persona traits and dialogue history, ensuring continuity and relevance during ongoing conversations. Once embodied, the persona becomes a live research entity, capable of being queried, adjusted, and iteratively explored. This approach offers a dynamic, hybrid method for accelerating early-stage research while maintaining design rigor and contextual sensitivity. Arguments and limitations of the effectiveness of persona simulation are detailed in Appendix C.

## BGB InsightGPT || User Simulator & Research Aide

By community builder A

This GPT helps you simulate user personas, conduct research, and generate requirements tables and concepts. Share your research goals to get started. ⚠️ This GPT may make mistakes. Avoid sharing sensitive data. MFA must be enabled on your OpenAI account to use ChatGPT for Bugaboo purposes. ⚠️

⚠️ How can I responsibly use InsightGPT and...

Tell me what you can do, InsightGPT. Be exact and brief.

I want to interview a Japanese mom from Tokyo who...

What are the latest stroller trends and user preferences I...

Ask anything

+

I want to interview a Japanese mom from Tokyo. Use your knowledge of Bugaboo segments and insights from reputable modern Japanese parenting resources to create a well-contextualized persona with local references from Bugaboo's segmentation.

Here's a persona based on Bugaboo's research documents and updated Japanese parenting trends:

### 1. Persona

- Name:** Ayaka Nakamura
- Age:** 34
- Location:** Setagaya-ku, Tokyo, Japan
- Profession:** UX Designer at a fintech startup
- Bugaboo Segment:** *Aspirational Achiever – Sophisticated Innovator*
- Distinguishing Characteristics:** Dual-language parenting (Japanese-English), "Mama Tech" Instagram accounts, prefers hybrid work and minimalist interior design with Japanese aesthetics.
- Local Quote:** "東京で育児するのは、効率と安心の両立が欠かせない" — "Realizing the balance of efficiency and peace of mind."

### 2. Traits

#### A. Environment & Lifestyle

- Child's Developmental Stage:** 7-month-old daughter; transitioning from bassinet to stroller.
- First Stroll with Baby:** At 2.5 months, post-sango care (postpartum rest) with (midwives) and husband's paternity leave.
- Stroller Usage Context:** Used for mall visits (Futako-Tamagawa Rise), pediatrician appointments, and meetups with other "mama tomo" (mom friends).
- Fashion Style:** Minimalist chic — COS, UNIQLO U, and Muji mixed with niche brands like Bugaboo and TODAYFUL.

Ayaka, could you share any pictures or videos and then highlight the uniquely Japanese aspects you find important related to your life, particularly those insight that designers at Bugaboo should take into consideration?

Hello! こんにちは、私は彩香 (Ayaka) です！  
Thank you for your question! Hmm... navigating Tokyo's public transport with a stroller is... *bag*.

Some days, it's a breeze—like when I take the Den-en-toshi Line rush. Setagaya Station, for example, has elevators, wide ticket gates, and staff who can quickly feed my daughter if needed.

But other times, it's really stressful! Navigating crowded trains with a stroller is a whole different challenge.

**Sources**

The Tokyo Chapter  
**TAKE A STROLLER TO JAPAN (& NOT JUST FOR BABIES)**  
April 18, 2025 — WHEN PACKING A STROLLER FOR JAPAN "If you are buying a new pram or stroller just..."

shopjapantruly.com  
**6 Best Baby Stroller in Japan 2025 – Japan Truly**  
April 9, 2025 — In Japan, there are two types of strollers known as "Type A" and "Type B" strollers,...

Tripadvisor  
**Pram/Stroller in public transport? - Tokyo Forum - Tripadvisor**  
March 13, 2025 — Japanese mom's use small strollers on trains and carriers. Sometimes they do not even...

**Uniquely Japanese Aspects for Stroller Design Consideration**

- Compactness and Foldability:**  
Tokyo's urban environment often requires navigating narrow sidewalks, crowded trains, and compact elevators. A stroller that is lightweight and can be easily folded with one hand is essential. This allows for quick transitions when boarding trains or buses, especially during peak hours when space is limited.

**Figure 18.** This collage shows a simulated interview with “Ayaka,” an AI-generated Tokyo-based mom. InsightGPT creates her persona, photo, and responses, helping designers explore local parenting needs—such as stroller compactness and ease of use in crowded public transport.

## 7.4. Developing InsightGPT: Interface and Design Rationale

InsightGPT was developed following early experiments with an existing synthetic user tool. While the initial system generated structured, detailed persona reports with strong contextual fidelity, it proved less effective in daily design workflows at Bugaboo. Designers described the tool's outputs as *"too heavy"* and difficult to integrate into fast-paced project activities. Olivia reflected this concern, noting: *"ChatGPT gives more actionable insights. It can show me pictures and help me do research."* Based on this feedback, a different approach was needed, one that prioritized conversational flexibility and visual engagement over static reporting.

As the research deepened, it also became clear that a persona-only tool would not sufficiently meet broader research needs. Designers required capabilities that could not only simulate user perspectives but also synthesize information, explore trends, and support real-time inquiry. Additionally, Bugaboo's IT team preferred a unified tool for compliance and security reasons. These needs pointed toward ChatGPT, which already offered multimodal capabilities, flexible query handling, and adaptable outputs. This led to the development of a custom version, InsightGPT, tailored to Bugaboo's segmentation models and research practices.

### 7.4.1. Moving to ChatGPT: Conversational Interfaces for Fast, Flexible Insight

Building on initial findings, I shifted to using ChatGPT for InsightGPT, which enabled designers to choose between detailed, narrative-rich responses and concise, structured takeaways. In one session, Rohan remarked, *"You can choose whether you want answers in a takeaway vibe or as a real interview,"* highlighting the new flexibility in controlling the level of detail. This capability allowed designers to tailor responses to the needs of either exploratory research or quick, actionable insights.

However, even with improved structuring, information overload remained a challenge. Designers noted that while responses became more organized, they often still contained excessive detail that required further filtering. Elisabeth commented, *"Sometimes it pulls in too much, and I have to filter what is actually useful,"* and added, *"I find it sometimes hard to extract useful things, it gives too many details that don't really influence my project."* These observations indicate that, despite enhancements, the limitless querying capability combined with AI's tendency for detail can make it difficult to extract the most relevant insights efficiently.

### 7.4.2. Seeing the User: Adding Visuals to Support Empathy and Imagination

Field observations also indicated that text-only personas often lacked emotional resonance. Without visual representations, designers found it more difficult to connect intuitively to the user context. Olivia remarked that visuals act as a *"bridge between the abstract and the practical,"* helping to ground discussions in relatable realities. InsightGPT was accordingly extended to include both AI-generated imagery and curated

web-based image retrieval, enabling designers to visualize personas and contextual scenes directly within their workflow. Elisabeth noted: *"It helps when you actually see them; it makes it feel like a real person... I find it easier to think about their needs when there's a face to attach to them."* Visual augmentation aimed to make persona interactions more tangible and to support intuitive reasoning about user needs.

## 7.5. Reflection and Learnings on AI-Augmented Information Action

### 7.5.1. What Worked: Strengths of InsightGPT in AI-Augmented Design Research

Through hands-on use in live projects, InsightGPT proved to be a practical and flexible support tool for early-stage design research at Bugaboo. Designers found it particularly effective in accelerating synthesis, generating relatable personas, framing problems interactively, and validating ideas through triangulation. These strengths made InsightGPT a valuable research companion, especially in fast-paced phases where time is short and direction is still forming.

This section explores four core areas where InsightGPT added the most value to the design process, demonstrating how generative AI can complement, rather than replace, human-centered research practices.

#### 7.5.1.1. Fast Synthesis: Turning Messy Research into Clear Summaries

A standout advantage of InsightGPT was its capacity to condense large volumes of qualitative input, research documents, persona libraries, or user feedback into clear, actionable summaries. Where traditional research methods require significant time for reading, sorting, and synthesizing, InsightGPT delivered on-demand overviews that sped up sense-making in time-sensitive design phases.

Designers could adapt the format of outputs to suit their needs. As Rohan put it: *"You can choose whether you want answers in a takeaway vibe or as a real interview."* This allowed for smooth transitions between high-level summaries and deeper narrative exploration, depending on where they were in the process.

Elisabeth noted a similar benefit: *"I've already used it several times to summarize documents,"* adding that it acted as *"a kind of helper to pull all the information together, without having to read the whole document."* For designers juggling multiple inputs and time constraints, this capability reduced cognitive overhead and gave them space to focus on higher-value creative tasks.

Importantly, the tool didn't just summarize, it structured. InsightGPT helped surface key themes, organize messy data into coherent patterns, and highlight areas for further investigation. Even when responses were occasionally verbose, the underlying clarity made it easier to separate signal from noise.

In practical terms, this meant teams could move faster from information gathering to design iteration. InsightGPT became a lightweight research companion, especially valuable



in the exploratory phase, where time is short, ideas are fluid, and direction needs to form quickly.

#### 7.5.1.2 Living Personas: More Empathy Through Dialogue and Context

One of InsightGPT's most valued features was its ability to bring personas to life through real-time dialogue and contextual specificity. Unlike traditional personas, which are typically static and high-level, AI-generated personas could speak, respond, and adapt to new scenarios, making them far more relatable for designers.

Elisabeth noted this during her Eleonore InsightGPT session: *"It helps when you actually see them, it makes it feel like a real person."* By combining visual cues with detailed narratives, InsightGPT helped bridge the gap between abstract user profiles and the lived experiences of real people. These lifelike representations not only improved engagement but also supported emotional connection and intuitive understanding, especially during early concept development.

Rohan highlighted the contrast with more academic sources: *"It makes it easier to relate"* when reading about a white noise feature scenario *"compared to reading a scientific article about how white noise helps a baby sleep."* Instead of abstract trends, designers could engage directly with personas grounded in context, culture, or parenting style, making user needs feel tangible and immediate.

Perhaps most importantly, InsightGPT helped shift designers' mindsets. As Elisabeth put it, *"It helps to create a kind of mindset switch... so you stop thinking just from your own view."* This cognitive shift, toward stepping into the user's perspective, reinforced empathy, supported deeper problem exploration, and could help sustain a user-centered design approach across roles and experience levels.

#### 7.5.1.2. Framing on the Fly: Reworking Problems Through Ongoing Dialogue

InsightGPT also supported a more dynamic approach to problem framing, giving designers the ability to iterate on their understanding as new questions emerged. Unlike traditional interviews, which are time-limited and final, AI personas offer a persistent space for exploration.

Olivia described this contrast clearly: *"With real interviews, the session ends, and you can't go back. But with AI, you can keep asking follow-ups."* This flexibility enabled designers to refine their hypotheses over time, probing deeper into specific needs, rephrasing questions, or testing ideas across different contexts.

Rohan pointed to this exploratory benefit: *"It helps to quickly place an idea in context, like, what if I place this in Norway?"* Designers could shift scenarios on the fly, exploring how a concept might land in different cultural or lifestyle environments. This adaptability made InsightGPT especially useful in early-stage projects, where framing is fluid and open-ended.

Together, these capabilities helped position InsightGPT not just as a tool for answering questions but also for asking better ones, supporting ongoing reframing and deeper contextual thinking throughout the design process.

#### 7.5.1.3. A Second Opinion: Using AI for Research Triangulation

InsightGPT also proved useful as a triangulation tool, helping designers cross-check fragmented or uncertain insights by generating alternative perspectives. Rather than treating it as a single source of truth, designers used the tool to compare their assumptions with synthesized data from diverse sources.

Rohan described this use clearly: *“I use it for triangulation; I don’t immediately trust what’s on the internet or in research, nor what I have in my head.”* In practice, this meant testing whether AI-supported perspectives aligned with previous findings, stakeholder opinions, or intuition. When themes repeated, like the dual function of stroller lighting for both safety and comfort, designers gained added confidence. When discrepancies emerged, it encouraged further investigation.

Elisabeth captured the tool’s exploratory value: *“It’s great for exploring, not necessarily for finding the truth.”* This framing, AI as a probe, not a verdict, positioned InsightGPT as a resource for broadening perspective and reducing blind spots rather than making decisions.

#### 7.5.2. The Learning Moments: When InsightGPT Fell Short

While InsightGPT provided clear value in accelerating early-stage research and facilitating persona-driven dialogue, its effectiveness diminished in areas that required autonomous exploration, critical thinking, and prioritization. During testing, designers consistently noted that the tool performed best when responding to well-structured queries and struggled when ambiguity, nuance, or assumption-challenging was required. This section outlines three key limitations observed during real-world use: its inability to independently reframe problems, the cognitive burden of extracting relevant insights from overly detailed outputs, and its tendency to reinforce rather than question existing assumptions, all of which underline the continued importance of human expertise in AI-augmented design research.

##### 7.5.2.1. InsightGPT Doesn’t Reframe Problems on Its Own

While InsightGPT proved valuable in synthesizing early-stage research and enabling rich persona engagement, its utility diminished when it came to independently reframing problems or surfacing unexpected insights. Unlike human researchers, who instinctively question assumptions and probe beyond the obvious, InsightGPT follows the structure and framing provided by the user. As a result, it often reinforces existing perspectives rather than challenging them.

Rohan described this limitation succinctly: *“The AI doesn’t really challenge you unless you deliberately ask it to. It mostly follows what you give it.”* This highlights a core issue: if the designer inputs a narrow question, the AI’s response remains constrained, lacking the generative push to broaden or question the problem space. Olivia noted a similar

experience: “[Country] has a cultural preference for compact designs, even among high-income users... but the AI didn’t highlight this insight immediately.” The insight only surfaced after additional prompting, revealing that AI does not automatically flag contextual nuances unless specifically asked.

This reactive behavior limits InsightGPT’s value as a stand-alone exploration partner. While it can elaborate on ideas and provide structured responses, it requires a skilled designer to drive the inquiry, supply framing breadth, and actively prompt alternative viewpoints. Without this human intervention, InsightGPT risks reinforcing surface-level knowledge rather than provoking the deeper reframing often needed in early design phases.

#### 7.5.2.2. *Too Much Info, Too Little Focus: The Cost of Overload*

Despite its ability to generate rich narratives and structured outputs, InsightGPT frequently overwhelmed users with excessive information. This volume, while comprehensive, often required manual filtering, diminishing the efficiency gains it was intended to provide.

Elisabeth summarized the challenge clearly: *“Sometimes it pulls in too much, and I have to filter what is actually useful.”* Similarly, Rohan noted, *“I find it sometimes hard to extract useful things, it gives too many details that don’t really influence my project.”* This tendency toward information overload placed a cognitive burden on designers, who had to sift through dense outputs to isolate actionable insights. Although InsightGPT improved on previous tools by offering more structure and organization, it lacked an internal mechanism to prioritize the most relevant takeaways for specific project needs.

The issue was compounded by the tool’s dependence on well-crafted input. As Rohan explained, *“If you ask a vague question, you get vague answers.”* Elisabeth reinforced this, adding, *“It’s really on you to structure the prompts well; bad questions lead to bad data.”* In short, while the tool responded effectively to targeted queries, it offered little assistance in helping designers refine or focus their framing.

Ultimately, InsightGPT’s utility was closely tied to the designer’s ability to guide the exchange. It was not a hands-off assistant but a responsive collaborator, capable of structuring and expanding on ideas, yet still reliant on human intent and clarity to deliver relevant, focused insights.

#### 7.5.2.3. *Prompt Dependency and Assumption Reinforcement*

A critical limitation of InsightGPT was its tendency to mirror existing knowledge and prompt structures rather than challenge or refine them. While the tool excelled at confirming known trends and organizing structured knowledge, it was notably less effective in introducing unexpected or disruptive perspectives, an essential element in problem reframing and innovation. This issue was particularly evident when designers sought culturally nuanced or context-specific insights. As Olivia noted during her session to design for a foreign country, InsightGPT failed to surface cultural design preferences unless explicitly prompted to do

so. Its passivity in assumption-challenging positioned it more as a confirmatory tool than one capable of pushing teams toward radical directions.

Furthermore, InsightGPT did not autonomously generate new perspectives or challenge underlying assumptions unless specifically instructed. Its value lies in acceleration and synthesis rather than independent reframing. As Elisabeth observed, AI-generated insights should not be accepted at face value but treated as prompts or triggers for rethinking assumptions. This reframing clarified InsightGPT's role as a tool for early-stage exploration and ideation, not a replacement for empirical research or real-world validation. Designers were thus advised to treat its outputs as hypothesis starters, ensuring that critical evaluation and validation remained central to the design process.

In addition, the quality and relevance of InsightGPT's responses were heavily dependent on the precision of the prompts it received. Poorly structured or overly broad queries consistently resulted in generic and unfocused outputs. Unlike human researchers who can navigate ambiguity, InsightGPT strictly adheres to the wording and structure of its input. This underscored the importance of prompt engineering as a key competency for designers leveraging AI-driven research tools. Without well-crafted queries, the effectiveness of the tool diminished significantly, highlighting the interdependence between human expertise and AI performance.

## 7.6. Technology Acceptance (TAM) Assessment of InsightGPT

To evaluate the broader acceptance of InsightGPT among Bugaboo's designers and product developers, a Technology Acceptance Model (TAM) survey was administered. The entire design and development team was invited to participate, and eight respondents completed the survey. The assessment measured perceptions across three dimensions: Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) (Davis, 1989). The full results can be found in Appendix D. A summary of the descriptive results is provided in Table 3.

Overall, InsightGPT received moderate to high acceptance, with an average TAM score of 3.51 out of 5 (PU: 3.63, PEU: 3.53, BI: 3.00). Participants expressed a combination of curiosity, excitement, and cautious optimism, while also voicing clear concerns about prompt complexity, information filtering, and practical relevance to specific workflows.

**Table 3.** Descriptive statistics for Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) of the TAM Survey Results for InsightGPT ( $n = 8$ )

Metric	Mean	SD	Median	Min	Max
PU	3.63	0.88	3.50	2.00	4.75
PEU	3.53	0.65	3.50	2.50	4.50
BI	3.00	1.07	3.00	1	4

### 7.6.1. Perceived Usefulness: Best for Early-Stage Exploration

The Perceived Usefulness (PU) dimension scored relatively high, averaging 3.63. Participants widely recognized InsightGPT's potential value in early concept framing and exploratory research. One participant described the tool as providing *"excitement, especially when I start designing a new product,"* noting that it helped to *"break through barriers"* created by prior experience and habit. Another highlighted InsightGPT's value for *"getting insights into users in other countries/cultures"* and *"reflecting on concept descriptions,"* emphasizing its usefulness for global research framing.

There was also strong appreciation for the tool's ability to challenge internal biases. One product developer noted that InsightGPT could *"reduce the risk of Bugaboo insiders' opinions and preferences,"* by offering more externalized, user-centered input during early product exploration.

However, usefulness varied based on job focus. Participants less directly involved in user framing or exploratory research expressed reservations. One participant stated that while InsightGPT was *"very interesting to explore,"* they were unsure about its immediate value without more extensive, workflow-specific examples.

### 7.6.2. Perceived Ease of Use: Prompting Confidence Varies by Experience

The Perceived Ease of Use (PEU) dimension averaged 3.53, suggesting moderate confidence in the tool's accessibility. Several participants found InsightGPT easy to navigate, with one describing it as a tool that could *"give quick insights instead of having to read through piles of documents."* Another participant praised how it helped to *"quickly get user feedback and input on needs and preferences"* during early concept phases.

However, participants also emphasized the sensitivity of the tool to prompting skill. As one noted, *"it can be challenging to give the right prompts"*. Others pointed out that overly general prompts tended to produce information that still needed significant *"filtering"* to become useful.

This feedback highlights a practical barrier to broader adoption: while the interaction model is familiar and usable, achieving high-quality outputs requires deliberate prompting strategies. Structured onboarding, with clear guidance on prompt formulation tailored to design research needs, could enhance ease of use for a broader group of practitioners.

### 7.6.3. Behavioral Intention to Use: Interest Is There, But Proof Still Needed

Behavioral Intention (BI) to regularly use InsightGPT averaged 3.00, reflecting moderate but cautious interest. Some participants, particularly those involved in early-stage innovation, expressed stronger commitment. One participant noted that InsightGPT was particularly useful for *"value proposition testing"* and *"initial validation of assumptions,"* positioning it as a valuable support tool during exploratory phases of product development. Another participant expressed excitement about using InsightGPT to *"explore different*

*perspectives*," helping to avoid reliance solely on prior knowledge when framing new concepts.

However, others signaled reservations about immediate, everyday integration into their workflows. One participant commented that while InsightGPT was *"very interesting to explore,"* they would need *"more experience with it first"* to fully trust its outputs, indicating that confidence in its consistent utility would only build over time and with practical exposure. Another participant reflected uncertainty about whether AI-generated inputs would *"rephrase into more obvious comments"* rather than deliver new or deep insights.

This suggests that while initial interest exists, broad adoption will depend on demonstrating concrete use cases where InsightGPT meaningfully accelerates, improves, or complements existing design and development workflows.

#### *7.6.4. What This Means: Adoption Hinges on Guidance and Relevance*

Overall, the refined TAM assessment of InsightGPT illustrates an optimistic but carefully balanced view of its integration potential at Bugaboo. Designers clearly recognize InsightGPT's potential value in generating rapid, unbiased user insights, particularly benefiting exploratory design stages and cross-cultural user research.

However, moderate average scores suggest ongoing caution driven by concerns over precise usability, prompt-engineering skills, and tangible applicability across diverse individual workflows.

### *7.7. Conclusion: InsightGPT as a Provocation Engine for Early-Stage Research*

InsightGPT was developed to address a pressing challenge in Bugaboo's design process: how to make early-stage research more dynamic, integrated, and actionable. Built around five core promises, adaptive persona development, first-person simulation, accelerated desk research, brand-aligned outputs, and multi-modal visual support, the tool was intended to reshape early-stage user understanding from a static checkpoint into a living, continuous activity embedded within daily design workflows.

Throughout structured sessions, benchmarking exercises, and survey feedback, InsightGPT cautiously delivered on its ambitions while also revealing critical boundaries that define its optimal use.

In persona development, the tool demonstrated its strength. Designers could quickly generate richly segmented, culturally anchored profiles that aligned with Bugaboo's internal frameworks. These personas included demographics, psychographics, motivations, fears, and even region-specific quotes, supported by realistic AI-generated images. Visual augmentation proved especially valuable, helping designers intuitively connect with user narratives rather than treating personas as abstract archetypes. However, the effectiveness

of persona generation depended heavily on input precision: well-structured prompts produced credible outputs, while vague ones led to more generic results.

The first-person simulation capability introduced a new modality for engagement. Designers interacted with live personas through open-ended dialogues, refining hypotheses and exploring behaviors in real time. InsightGPT's use of context memory ensured that traits and persona preferences carried over as the interaction evolved, creating a coherent and believable persona experience. Yet, an important limitation surfaced: the AI was reactive rather than proactive. It could adapt and elaborate but rarely challenged assumptions or reframed problems independently, a gap that newer tools such as Synthetic Users' Prisma™ are beginning to address through structured exploration scaffolding. For now, critical reframing and deeper exploration remained squarely human tasks.

Beyond personas, InsightGPT accelerated desk research by synthesizing large information sets into structured, accessible outputs. Designers could surface cultural insights, behavior patterns, and scenario-specific user needs within minutes. The tool was particularly useful for generating hypotheses and identifying broad trends, with references, but it struggled with quantitative precision. Estimates of user preferences frequently diverged from empirical survey data, reinforcing the need for human validation of AI-generated findings.

InsightGPT's brand alignment was a consistent strength: outputs adhered to Bugaboo's segmentation language and consumer definitions, offering reliable continuity across exercises. However, this fidelity also highlighted a maintenance risk; the tool's relevance depends on keeping internal references updated as brand frameworks evolve.

Taken together, these capabilities profoundly shifted how information action could occur during the Frame phase of the Frame–Propose–Evaluate (FPE) cycle. InsightGPT transformed early-stage research from a slow, report-heavy exercise into a dynamic, real-time dialogue, allowing designers to surface, structure, and iterate on user understanding as their projects evolved. Instead of waiting for formal research rounds, they could continuously refine assumptions, explore alternative futures, and ground their decisions more fluidly in emerging insights.

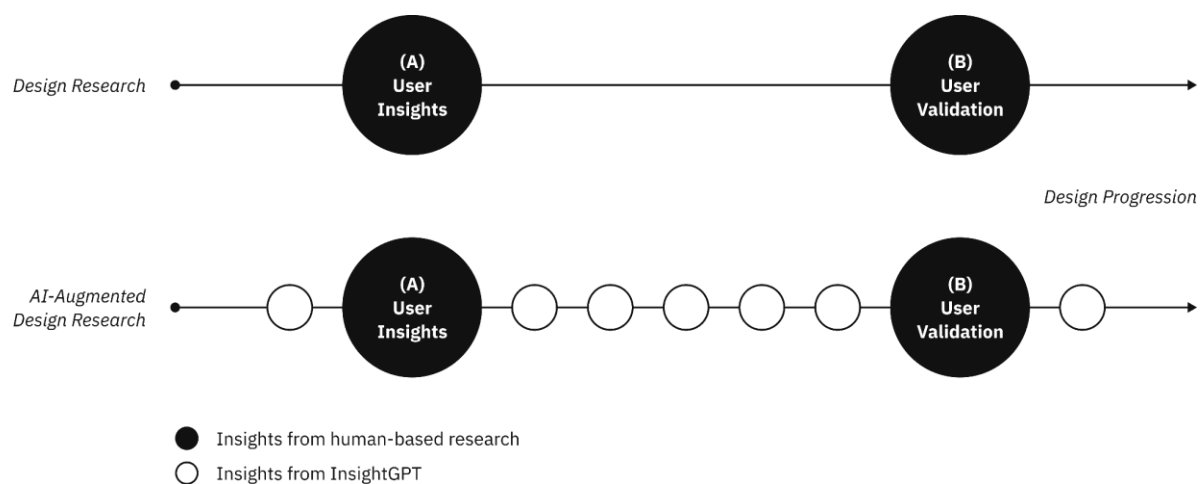
Yet this shift comes with important caveats. InsightGPT's effectiveness is tightly linked to the designer's ability to frame precise prompts, critically evaluate outputs, and maintain an active role in questioning assumptions. The tool does not independently reframe problems or challenge surface-level perspectives; it mirrors the intent and structure provided by its user. Moreover, while it excels at qualitative synthesis and persona enrichment, it should not be relied upon for precise quantitative predictions.

In this light, InsightGPT should be understood not as a replacement for traditional research practices but as a provocation engine, one that accelerates early exploration, broadens the investigation space, and stimulates richer questioning. It augments the beginning of the

research journey: helping designers ask sharper questions, explore alternative contexts, and form more grounded hypotheses before committing to direction.

Used deliberately, with clear intent, skilled prompting, and critical oversight, InsightGPT can become a powerful complement to traditional design research. It is especially valuable in fast-moving, exploratory contexts where conventional methods may be too slow, too static, or too resource-intensive. For Bugaboo teams, it means moving toward more continuous insight loops, making the design process more responsive (Figure 19).

Ultimately, the promise of InsightGPT is not to diminish the role of designers but to strengthen it. It invites designers to work more fluidly with information, to stay curious longer, and to embed iterative learning into the heart of the design process.



**Figure 19.** AI-augmented research with tools like InsightGPT enables designers to generate and refine user insights more frequently throughout the design process. Compared to traditional approaches with fixed insight and validation points, InsightGPT supports lightweight, ongoing interactions that promote iteration, exploration, and responsiveness earlier and more often in the design progression.



## 8. AI for Proposing: Exploring the Potential of CreAIte to Augment Representation Action

### *8.1. Introduction: CreAIte and Early-Stage Proposing at Bugaboo*

This chapter examines the development, application, and evaluation of CreAIte, a custom generative AI workflow designed to augment early-stage design representation at Bugaboo.

Early-stage proposing, where abstract ideas begin to take visual form, is a critical part of product development. It demands fast iteration, broad exploration, and early translation of concepts into tangible, communicable artifacts. For designers at Bugaboo, this phase presents an opportunity to open creative directions, provoke reflection, and build early alignment across teams. Yet traditional tools, manual sketching, CAD modeling, and detailed rendering, can slow this momentum, introducing friction just when rapid divergence is most needed.

CreAIte was developed to address this opportunity. By integrating three AI tools, PromptGPT, KREA, and Midjourney, into a unified workflow, CreAIte aimed to accelerate visual iteration. It supports designers in externalizing ideas faster, exploring broader morphological and aesthetic directions, and iterating in high fidelity with greater agility. Rather than replacing manual tools, CreAIte complements and extends them, helping designers visualize more possibilities faster and with less friction. In doing so, early-stage representation can be shifted from a labor-intensive process to a more adaptive one.

Through research sessions with four Bugaboo designers, spanning pattern design, product development, and styling, CreAIte was tested across varied use cases: from accessory design and CMF exploration to stroller component ideation and supplier communication. Reflections gathered during these sessions evaluated both the opportunities CreAIte enabled and the limitations it exposed.

Findings revealed tangible benefits. Designers reported faster divergence, richer visual experimentation, and stronger early alignment with stakeholders. CreAIte helped externalize ideas quickly, keeping exploration grounded in Bugaboo's brand language. However, challenges surfaced: structural control remained limited, brand details often drifted across iterations, and the abundance of AI outputs risked decision fatigue. These limitations highlighted the importance of prompt fluency, deliberate tool use, and human judgment to guide AI-augmented workflows effectively.

The sections that follow detail these findings. Section 8.2 outlines the research participants and session contexts; Section 8.3 introduces the CreAIte workflow and its components; Section 8.4 explores its application and refinements; Section 8.5 reflects on its role in early-stage proposing; and Section 8.6 presents a Technology Acceptance Model (TAM) assessment, concluding with Section 8.7.

## 8.2. Participants and Research Sessions

Four Bugaboo designers participated in research sessions to assess CreAItE's effectiveness in live design contexts. Each session focused on early-stage concept development, testing how generative AI could accelerate exploration, expand creative directions, and support brand-aligned visual outputs.

- **Hannah**, Senior Pattern Designer with over seven years of experience at Bugaboo, collaborated in a hands-on exploration to design stroller pocket placements and fabric pattern variations. The focus was on translating visual prompts into functional and stylistically consistent textile designs.
- **Natasha**, Product Designer with more than two years of experience at Bugaboo, took part in two sessions and one follow-up reflection. In the first, we focused on generating and refining AI-assisted visual variations of seat inlays, evaluating how different silhouettes and padding cues could be explored using KREA and Midjourney. In a separate set of sessions, we explored backrest curvature adjustments using AI tools to provoke new engineering and form factor conversations, tracking how initial AI-generated outputs were received across technical and design stakeholders.
- **Olivia**, after engaging with InsightGPT, Olivia used CreAItE in one sessions to create culturally resonant stroller designs for dense urban areas.
- **Victoria**, Styling Product Lead Designer with three years at the company, joined four AI-supported design sessions and a joint reflection with Natasha. She focused on transforming mood boards into accessory design concepts, developing CMF (Color, Material, Finish) proposals, and preparing visual materials for supplier communication, all while maintaining Bugaboo's brand identity.

*For confidentiality reasons, the detailed session contents and outcomes have been omitted, and the names have been replaced with pseudonyms.*

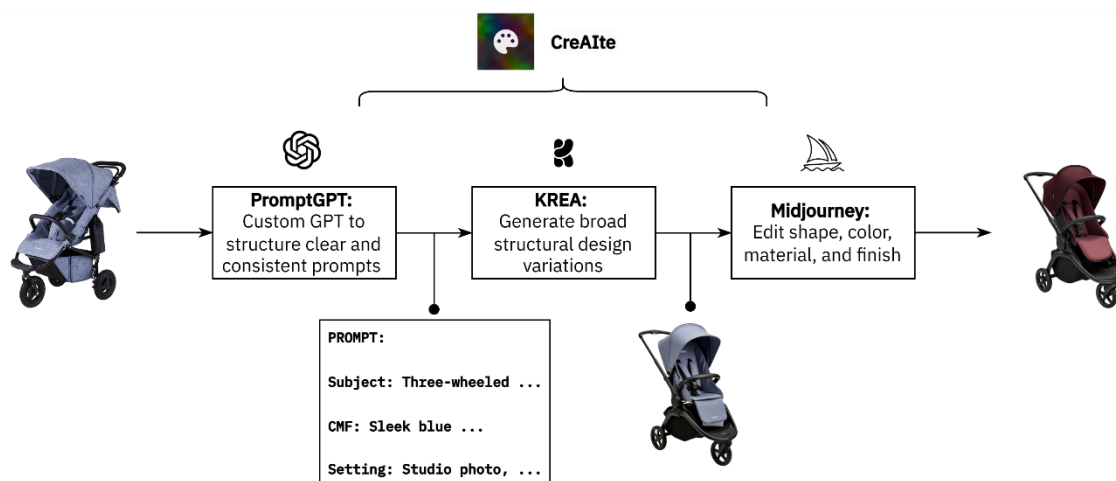
## 8.3. Study Material: The CreAItE Workflow (PromptGPT + KREA + Midjourney)

CreAItE is a multi-tool generative AI workflow developed to enhance early-stage design iteration by integrating three distinct yet complementary components: PromptGPT, KREA, and Midjourney. Each tool plays a defined role in the iterative process, transforming conventional labor-intensive representation into a more dynamic workflow.

The workflow was developed through hands-on experimentation and is designed to reduce friction, support creative flow, and make it easier to quickly try out and adjust different design directions (Figure 20).

- **PromptGPT** functions as a starting point, helping designers generate clear, structured prompts aligned with brand language and design intent. This lowers the entry barrier and ensures consistency across outputs.
- **KREA** handles early-form exploration by producing broad morphological variations. It allows designers to generate multiple concept directions quickly, bypassing time-consuming manual sketching and modeling.
- **Midjourney** supports aesthetic refinement, focusing on CMF (Color, Material, Finish) and detailed visual adjustments. It enables image-to-image editing, retexturing, and style alignment based on design inputs from earlier stages.

Together, these tools form a continuous, feedback-rich loop, allowing designers to explore, refine, and reframe concepts with greater speed and creative breadth. Rather than replacing manual representation, CreAIte expands its possibilities, offering a scalable, AI-assisted pathway for early-stage design work.



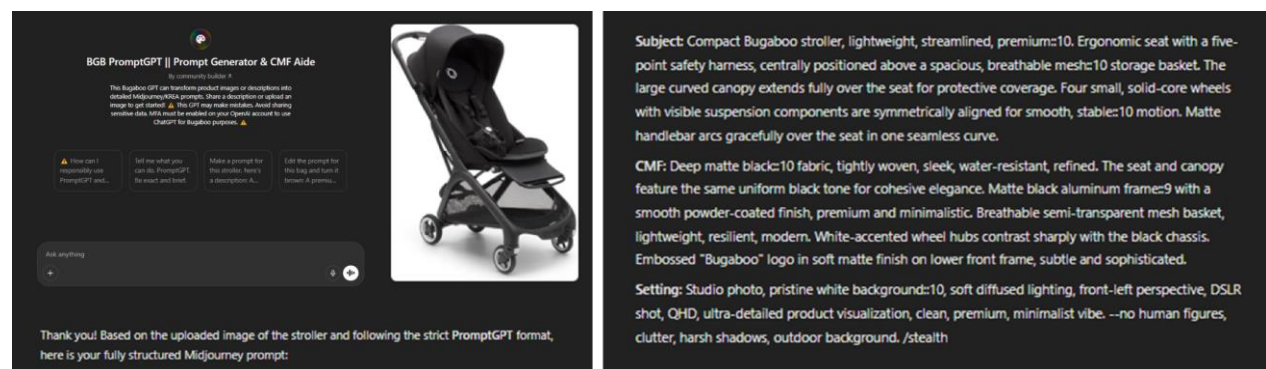
**Figure 20.** CreAIte integrates PromptGPT, KREA, and Midjourney into a unified workflow that supports fast, iterative design development. PromptGPT helps designers frame structured prompts; KREA generates diverse variations; and Midjourney refines outputs with attention to aesthetics and CMF details. This workflow enables designers to explore and iterate visually with great speed and creative flexibility.

### 8.3.1. PromptGPT: Creating Better Prompts for Consistent Visual Output

PromptGPT forms the foundation of the CreAItE workflow. Built as a custom ChatGPT instance, it was developed to address one of the primary barriers to effective generative AI use in design: the difficulty of crafting structured, high-quality prompts. By translating informal ideas or images into consistent, brand-aligned input for tools like Midjourney, PromptGPT ensures that designers can generate reliable outputs.

As illustrated in Figure 21, PromptGPT enables designers to convert product images or casual descriptions into complete, detailed prompts. These prompts follow a fixed structure focused on three main areas: the subject, CMF (Color, Material, Finish), and the setting. The subject defines the product, its part relationships, and its core form factors. CMF specifies the color palette, materials, and textures, using controlled repetition and weighting to direct emphasis. The setting describes the environment, lighting, camera angle, and background, ensuring the generated visuals are presentation-ready.

PromptGPT also incorporates Midjourney's syntax to refine prompt precision. Features are emphasized using the :: syntax, while undesired elements are excluded using the --no command. This ensures that the outputs are focused and visually coherent. Additionally, the system supports interactive refinement through conversational inputs, allowing designers to iteratively adjust prompts without needing to start over.



**Figure 21.** PromptGPT helps designers translate product images or informal descriptions into detailed prompts for generative tools like Midjourney. Using a fixed structure—covering subject, CMF, and setting—it ensures consistent visual output while allowing designers to refine prompts interactively. The example illustrates how a stroller image is converted into a complete, optimized prompt ready for rendering.

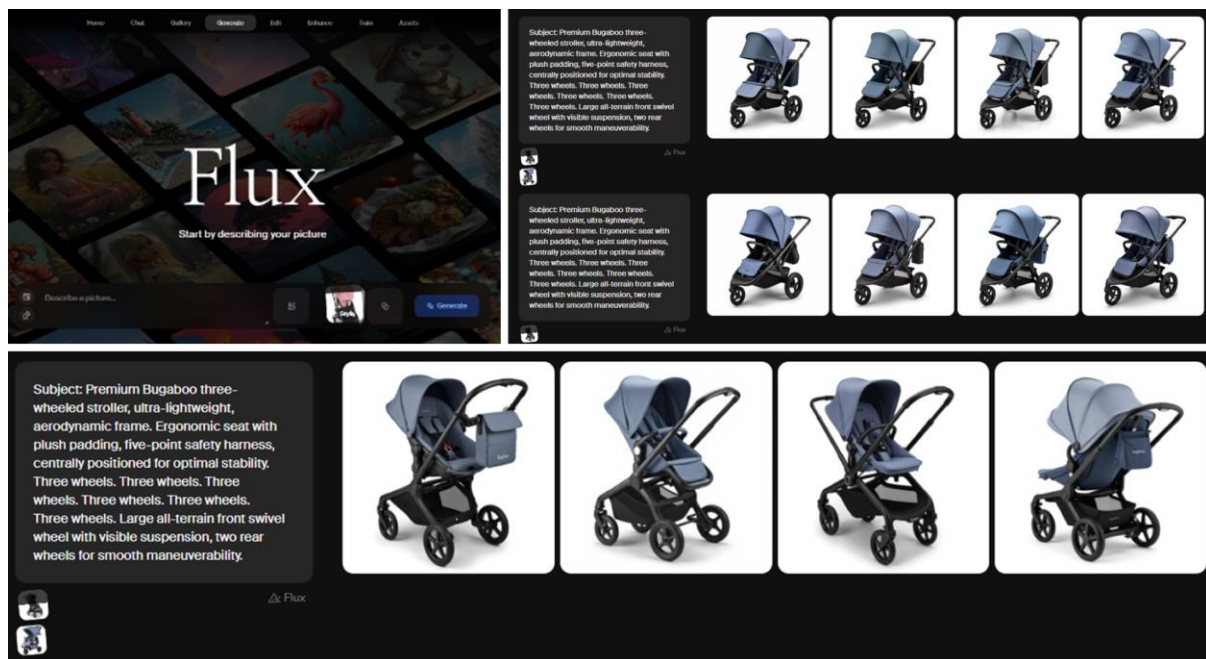
By enforcing a standardized prompt structure and offering real-time refinement capabilities, PromptGPT significantly reduces inconsistency and accelerates the creation of on-brand, high-quality visual concepts. It enhances the usability of generative AI in dynamic design contexts, making these powerful tools more accessible and effective for creative teams.

### 8.3.2. KREA: Fast Exploration of Shape and Structure

KREA serves as the form-generation engine within the CreAItE workflow, enabling designers to explore a wide range of morphological variations quickly and without the overhead of high-fidelity modeling. It is especially suited to early design phases, where speed, flexibility, and breadth of exploration are critical.

The platform supports custom AI model training, allowing designers to incorporate up to 50 images into a personalized model. In this specific application, 50 high-quality images of Bugaboo strollers were used to fine-tune the model, ensuring that the generated outputs align closely with the brand's visual identity. Designers have the ability to adjust the influence of the Bugaboo style in the resulting visuals, offering control over how strongly the brand characteristics appear.

As seen in Figure 22, KREA supports both text-to-image and image-to-image generation. Designers can input structured text prompts or upload reference images to create alternative shape iterations of a product. This functionality enables quick experimentation with the overall design.



**Figure 22.** KREA enables rapid generation of form variations using structured prompts and image inputs. Shown here is a series of stroller concepts generated from a custom-trained AI model fine-tuned on 50 Bugaboo images. The tool supports wide-ranging morphological exploration while allowing designers to control brand fidelity, making it ideal for fast, early-stage concept development within the CreAItE workflow.

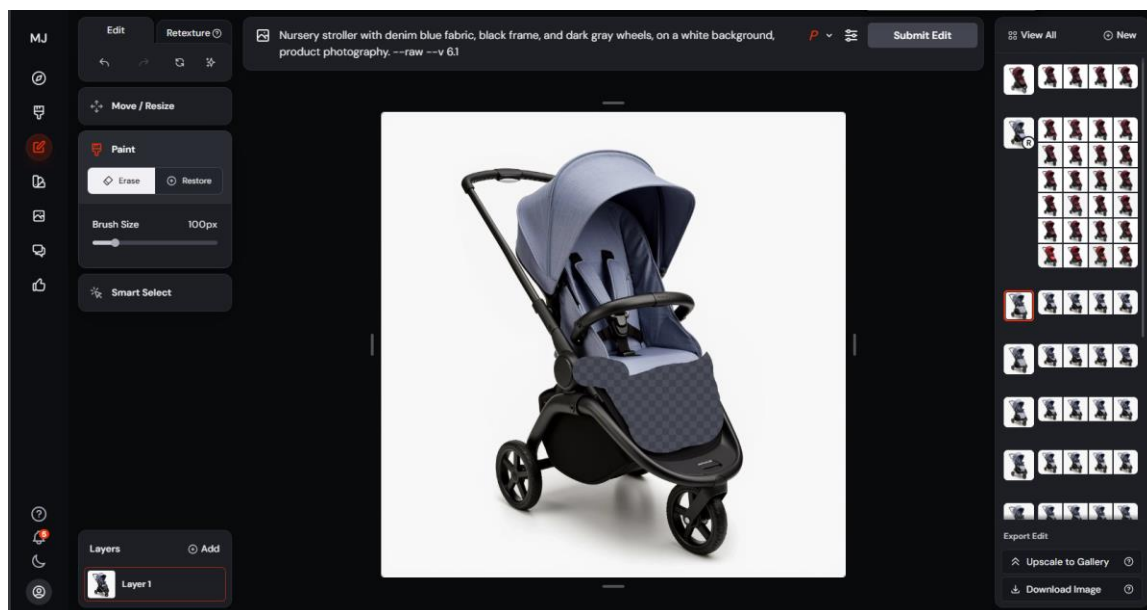
As part of the CreAItE workflow, KREA serves as a dedicated tool for structural exploration. It streamlines the process of early-stage design iteration, helping teams efficiently develop and evaluate a wide range of concept directions.

### 8.3.3. Midjourney: Fine-Tuning Style, Detail, and CMF

Midjourney acts as the final refinement tool within the CreAItE workflow, focusing on material realism, texture articulation, and aesthetic precision. While KREA facilitates broad structural exploration, Midjourney supports the transition toward a more polished product vision by enabling detailed visual enhancement and stylistic consistency.<sup>3</sup>

The platform allows for custom AI model training, similar to KREA, and supports the integration of curated mood boards. For this application, three boards guided the AI's style: one with 100 close-up images of accessories and details, one with 100 images of full-size strollers, and one with 89 compact stroller images. These targeted datasets helped ensure visual diversity while staying true to the Bugaboo brand.

Designers can engage with Midjourney through both text-to-image and image-to-image generation, using structured prompts or reference visuals to refine and elevate concepts. The platform also supports retexturing, which allows for comprehensive CMF transformations, such as changing a matte plastic surface to brushed aluminum, without altering the underlying geometry. In addition, built-in masking tools provide selective modification capabilities, giving designers the ability to make localized changes while preserving the rest of the design (Figure 23).



**Figure 23.** Midjourney allows designers to make localized edits through masking, enabling selective changes to materials, textures, or colors without altering the full image. In this stage of the CreAItE workflow, designers fine-tune specific elements—such as fabric finishes or CMF details—to bring concepts closer to brand-aligned, presentation-ready visuals.

<sup>3</sup> Note on not using generative sketching tools like Vizcom: Early in the project, these tools lacked the maturity needed for effective use. KREA and Midjourney were chosen for their usability, existing licenses, and clear workflows. Since then, generative sketching tools have evolved rapidly and are worth exploring in future work.



## 8.4. Developing CreAIte: Interface and Design Rationale

The evolution of CreAIte, integrating PromptGPT, KREA, and Midjourney, has been driven by ongoing, real-world design experimentation. Throughout multiple sessions, designers engaged in iterative cycles with the system, providing firsthand observations and reflective notes that have guided continuous refinements. The following findings, drawn from session notes and reflective analysis, illustrate the developmental trajectory of CreAIte rather than serving as an evaluative assessment of its performance. Quotes are included to capture designers' authentic experiences, challenges, and insights, offering a nuanced understanding of how CreAIte evolved through practice.

### 8.4.1. Where AI Fell Short: Control, Consistency, and Brand Fidelity

#### 8.4.1.1 Structural Precision and Unintended Random Changes

One of the most immediate limitations designers encountered was the lack of precise control in localized adjustments. While effective in generating broad shape variations, KREA struggled to execute small, intentional refinements. This was especially apparent in sessions where designers attempted to fine-tune geometry. As Natasha remarked during a backrest exploration session, *“It’s quite difficult to do [changes] specifically,”* capturing the frustration of attempting detailed edits without affecting unrelated areas.

Attempts to use Midjourney’s erase and redraw tools as a workaround produced similarly inconsistent outcomes. Designers often relied on trial and error, with one participant commenting, *“Maybe we can remove that line... let’s just generate and see.”* These moments revealed a core challenge: while generative AI could inspire new directions, it was far less reliable when used for controlled, incremental modifications (Figure 24).

Ultimately, this reinforced the idea that CreAIte’s strengths lie in conceptual expansion and early-stage ideation rather than in fine-grain refinement.



**Figure 24.** This example shows a series of seat base iterations generated with Midjourney. While useful for inspiration and early exploration, the tools often introduced unintended changes in adjacent parts of the design. Designers found it difficult to apply precise, isolated edits, highlighting the current limitations of control and predictability in AI-assisted refinement.

#### 8.4.1.2. Struggles With Brand Identity and Material Detail

Another challenge that emerged early was the system's difficulty in maintaining brand identity and material fidelity across iterations. In one session focused on accessory design, Victoria noted, *"It's completely getting rid of the Bugaboo logo... that's something [that] could have been expected."* This reflected a common issue where brand-specific elements, logos, stitching patterns, and hardware design were either omitted or distorted in generative outputs.

Similar difficulties arose in rendering materials with high fidelity. During a stroller concept session, Hannah observed that *"it struggles with fine mesh detailing, it tends to simplify or turn it into something ribbed instead."* Such observations confirmed that the current generation of visual AI tools, while powerful in broader visual storytelling, still struggles to preserve detailed identity cues, especially in layered, CMF-heavy products like strollers.

As a result, designers began to use CreAIte selectively as a tool for creative expansion and ideation, not for final-detail representation or brand-sensitive outputs.

#### 8.4.2. Refinements: How Designers Made CreAIte More Reliable

As designers became more familiar with CreAIte's behavior, they began to experiment with methods to improve its reliability and creative control. These refinements, focused on prompt structure, image referencing, masking, and collage, played a crucial role in shaping the tool's usability. Over time, what began as trial-and-error evolved into a more systematic set of best practices for working with generative AI in early-stage design.

##### 8.4.2.1. Stabilizing Outputs with Better Prompts and Reference Images

One of the earliest and most effective refinements came from combining text prompts with reference imagery. Designers observed that without clear instructions, the system often produced arbitrary results. As Hannah noted, *"If you give it no instructions, it just makes random decisions, so refining prompts is key."*

As can be seen in Table 4, Midjourney and KREA each exhibited different strengths: Midjourney excelled in editing and retexturing but struggled with generating realistic, broad structural changes. KREA, by contrast, was strong in generating varied forms but lacked control over surface-level detail. By using PromptGPT to create structured, consistent prompts and pairing these with carefully selected reference images, designers were able to significantly increase the predictability and coherence of outputs.

This realization helped clarify tool roles within the workflow, encouraging designers to use each AI system more deliberately according to their specific phase of exploration.



**Table 4:** This table compares KREA and Midjourney outputs across three prompt strategies. Generic prompts produced unrealistic, off-brand results, especially in Midjourney. Structured prompts from PromptGPT improved consistency, and combining them with reference images and Bugaboo-trained models yielded the most reliable outputs. KREA's visuals were generally more realistic and product-relevant, while Midjourney often generated more fantastical or stylized interpretations.

Prompt Detail	KREA	Midjourney
<b>Prompt:</b> "A three-wheeled stroller"		
<b>Prompt GPT Prompt</b> <b>Subject:</b> Premium three-wheeled ... <b>CMF:</b> Heathered denim blue fabric, matte black frame, ... <b>Setting:</b> Studio photo, soft lighting, white background, ...		
<b>PromptGPT Prompt + Reference Image + Bugaboo Style</b>		

#### 8.4.2.2. Using Masking to Localize and Control AI Changes

To further improve control during image editing, designers turned to Midjourney's masking capabilities. By isolating areas for modification, they were able to contain AI-driven changes to specific zones without compromising the integrity of the design (Figure 25). During an inlay session, Natasha reflected, "When we masked only around the fixation points, AI played within those constraints, keeping the design cohesive."



**Figure 25.** These examples show how masking was used to localize AI-driven changes to specific parts of stroller seat inlays, such as padding patterns or stitching details, while preserving the overall form and structure. This approach allowed designers to experiment with refined variations without compromising consistency, making masking a key technique for controlled, late-stage iteration.

This approach proved particularly effective when more subtle refinements were needed. Instead of re-generating the entire image, designers could adjust individual components, while preserving the core visual identity of the concept. Masking became a go-to method for iterative, controlled tweaks late in the ideation cycle.

#### 8.4.2.3. Improving Control with Collage Techniques

A third, highly effective strategy emerged through the use of collage. By layering or combining image elements, designers could generate integrated, coherent outputs. This proved especially useful in contexts where preserving visual DNA was critical (Figure 26).



**Figure 26.** This illustrative example shows how a basic collage element (left) was used to guide AI refinement, resulting in a polished, brand-consistent output (right). The approach helped designers bridge rough ideas and high-quality visuals while preserving core intent.

During a session focused on stroller concepts, Olivia captured the excitement of this approach: “This is great! I can go from a rough idea to a high-quality visual just like that.” The collage method bridged creativity and control, allowing teams to introduce novelty without losing fidelity to brand or function.

#### 8.4.2.4. Sketch-to-Concept: Using Hand-Drawings to Guide the AI

A final use case that emerged during the refinement of the CreAIte workflow was the seamless transformation of hand-drawn sketches into realistic visual concepts (Figure 27). This process bridged early ideation and high-fidelity representation, enabling designers to move from abstract outlines to visual proposals with minimal manual rendering effort.



**Figure 27.** This illustrative example shows how a simple hand-drawn sketch (left) can be transformed into a detailed, brand-aligned concept render (right) using the CreAIte workflow. The process helped designers move quickly from early ideas to polished visuals, reducing manual rendering effort.

In one example, a simple line sketch of a soft tote accessory (left) was processed through CreAIte, ultimately producing a highly resolved, brand-aligned visual concept (right). This transition, from structural intent to rendered design, highlighted the potential of generative AI to compress time-consuming visualization steps into a more fluid, iterative flow.

### 8.5. Reflection and Learnings on AI-Augmented Representation Action

This section evaluates CreAIte's role in the representation process, focusing on its capacity for rapid conceptual divergence, iterative refinement, and enabling decision-making. The evaluation highlights both its strengths and limitations in supporting dynamic design exploration, particularly in its ability to facilitate rapid divergence while maintaining control over refinement and precision. The following discussion examines CreAIte's role in design workflows through two perspectives: its strengths in accelerating early-stage concept generation and its challenges in structured refinement and detail preservation.

#### 8.5.1. What Worked: Strengths of CreAIte in Rapid Visual Iteration

CreAIte delivered clear advantages in early-stage design workflows, particularly in accelerating ideation, structuring visual exploration, and enabling faster, more fluid iteration. By integrating PromptGPT, KREA, and Midjourney into a seamless workflow, designers were able to externalize concepts more rapidly, generate structured visual

variations, and align teams more effectively during the initial phases of product development. These strengths became most apparent in four key areas: rapid visualization, transitions from low- to high-fidelity outputs, experimentation, and CMF exploration.

#### 8.5.1.1 From Hours to Minutes: AI for Fast and Flexible Visualization

CreAIte's most immediate and widely recognized benefit was its ability to dramatically accelerate early-stage visualization. Where traditional sketching or rendering methods might take hours, CreAIte enabled designers to externalize ideas in minutes. Olivia captured the impact clearly: *"Doing this with AI takes one minute. Manually, it takes hours."*

This speed gave designers more space to explore broadly without being constrained by time or resources. Victoria emphasized this during early-stage ideation: *"It was really useful to quickly visualize things that we had in mind... to actually see things very quickly."* Similarly, Natasha reflected on the time cost of legacy workflows: *"I spent hours and hours making all these outlines... It would have been super quick to visualize different [options]."*

Rapid visual output proved especially valuable during ambiguous phases of design, moments when direction remains uncertain. As Natasha described: *"We know what we don't want, but we don't know exactly what we do want."* In such cases, AI-generated visuals helped surface multiple directions simultaneously, supporting reflection and discussion.

This ability to quickly move from an idea to a visual artifact supported the principle of expandable rationality, enabling broader exploration without the proportional increase in time or cognitive load. Designers could test more concepts, compare options, and iterate faster, ultimately improving both the pace and quality of early decisions.

Beyond speed, CreAIte served as a nimble intermediary between hand sketches and advanced rendering tools. As Victoria noted, *"Before I jump into CLO or KeyShot, I'll use AI for quick iterations."* Rather than supplanting high-fidelity rendering or final material validation, CreAIte facilitated early-stage CMF exploration within well-defined constraints, enabling teams to narrow down viable directions before committing to manual refinement. This lightweight step streamlined the workflow, empowering designers to visualize, assess, and iterate on ideas with greater agility and clarity.

#### 8.5.1.2. Generating Variations to Break Fixation and Spark New Ideas

CreAIte played a role in enhancing idea generation by enabling rapid, structured variation. Instead of committing early to a single design direction, designers could quickly explore multiple alternatives in parallel, maintaining creative momentum during the often ambiguous early stages of concept development.

Natasha highlighted how AI shifted her creative process: *"Even if I had used Photoshop, I would have been restricted... AI helped us step away from constraints and discuss new possibilities."* Traditional tools like Photoshop demand more manual effort for each variant, whereas CreAIte enables lightweight, high-volume iteration, often generating dozens of visual alternatives in a matter of minutes.

This breadth of output helped clarify fuzzy ideas and stimulate discussion. As Natasha noted, *“Once you’re in Photoshop... there’s no way for you to make 20 different lines at the same time.”* With CreAItE, design teams could quickly generate a visual landscape of options, then respond, refine, or pivot based on what resonated.

Unexpected outcomes also became a source of inspiration. Victoria reflected on how AI-generated material variations sparked new thinking: *“It’s not what I expected, but there’s something interesting here... maybe we can push it further.”* These surprising results, while not always aligned with initial intent, provoked useful creative departures that may not have emerged through conventional means.

By acting as both a visual amplifier and a provocation tool, CreAItE supported a more exploratory mindset. Designers were no longer limited to internal ideation alone; they could respond to AI-generated prompts, expanding their creative bandwidth while maintaining alignment with structural and brand constraints.

#### *8.5.1.3. Making Ideas Click: Using Visuals to Align Teams Early*

In addition to accelerating idea generation, CreAItE proved unexpectedly valuable as a tool for reflection, helping design teams align more effectively with engineers and stakeholders early in the process. Transforming abstract ideas into concrete visuals allowed for faster, more informed discussions across disciplines.

Rather than limiting itself to creative exploration, CreAItE’s quick visual outputs served as collaborative anchors. Designers used them to communicate concepts clearly and in a brand-aligned format. As Victoria explained, *“To show it to other people... this gives it an extra layer because you can already visualize what others have and kind of in a Bugaboo way.”* These early visuals helped ensure that initial ideas were understood before transitioning to more resource-intensive stages like CAD or physical prototyping.

Natasha echoed this benefit: *“Definitely at the beginning of the process. Ideation, brainstorming... visualizing ideas.”* She also emphasized how CreAItE improved technical collaboration: *“...it was pretty useful to communicate some ideas to the engineers.”*

By enabling quick exploration of multiple directions and making ideas more tangible, CreAItE helped reduce misalignment, clarify intent, and facilitate faster consensus. The tool supported a smoother transition from individual ideation to collective reflection, ultimately streamlining early-stage decision-making and reducing rework later in the process.

#### *8.5.2. The Learning Moments: Where CreAItE Fell Short*

While CreAItE significantly enhanced early-stage ideation and accelerated conceptual exploration, it also exhibited notable limitations that restricted its effectiveness in structured iteration. These challenges primarily stemmed from AI’s lack of precision in controlled refinements, difficulties in handling structurally complex products,

inconsistencies in branding and design identity retention, and the risk of over-iteration leading to decision fatigue.

#### 8.5.2.1. When You Know What You Want: The Limits of Control and Precision

While CreAIté proved powerful for early-stage exploration, its limitations became apparent when designers attempted more precise, localized changes. The tool excelled at generating broad morphological variations but struggled with controlled refinements, particularly in advanced stages of concept development.

Natasha encountered this during a backrest design session, noting: *“It’s quite difficult to do specifically.”* Even a small tweak, like adjusting the curvature of a frame, often triggered unrelated shifts in the overall design. This lack of granularity led her to reframe the tool’s role, treating it more as a source of inspiration than a precise design instrument.

Victoria experienced similar issues. As she put it: *“You go to a place where you are happy, but then you keep going, and it starts shifting away from what you want.”* The inability to lock in promising directions made iterative refinement frustrating as outputs became increasingly misaligned with the original intent. Over time, this reduced the efficiency gains CreAIté had offered during earlier stages.

These frustrations were particularly evident as projects progressed and design intent became clearer. Victoria explained: *“The more you know what you want, the less useful it is.”* At that point, she preferred transitioning to traditional tools like CLO or Illustrator, where greater precision and control allowed her to build out exact specifications: *“I would actually start building things on 3D myself... the usual design process.”*

Ultimately, the challenge was not with AI’s creative range but with its unpredictability in controlled contexts. Natasha summarized it clearly: *“It wasn’t really controlled exploration... You don’t control the outcome.”* While CreAIté supported expansive ideation, it lacked the resolution needed for targeted refinements, highlighting the importance of hybrid workflows where traditional tools remain essential for detail-level execution.

#### 8.5.2.2. Looks Can Mislead: Struggles with Structural Complexity

CreAIté showed clear weaknesses when applied to structurally complex products like strollers, where safety, mechanical function, and manufacturability are central. Unlike softer categories such as accessories, where form and material dominate, stroller development demands technical precision, an area where AI consistently falls short.

In multiple sessions, designers noted that while AI-generated visuals were polished, they often lacked functional logic. Olivia summarized the issue during her session: *“It looks like it could work, but when you actually break it down, it makes no sense.”* The deceptive fidelity of these visuals risked misleading teams into treating them as viable when they were, in fact, structurally implausible.

This gap between appearance and feasibility became a recurring point of frustration. In her session, which focused on the seat backrest, Natasha described the experience as *“one of the most frustrating sessions of all.”* Having already invested significant time outlining the geometry manually, the lack of viable AI results was demotivating: *“I already did the outlines... I didn’t like anything.”* The mismatch between her expectations and what the tool delivered underscored CreAIte’s limited value in high-precision design contexts.

Victoria’s earlier insight again held true: *“The more you know what you want, the less useful it is.”* For well-defined structural challenges, designers preferred more deterministic tools. However, Natasha also noted that CreAIte might have been more helpful had it been introduced earlier: *“If we had this tool a year earlier... it would have saved time.”* This reflects its stronger utility in early ideation rather than during detailed development.

A key concern was that CreAIte’s high-fidelity outputs could be misread as functional proposals, especially when communicating with partners. Unlike rough hand sketches, which signal ambiguity, AI renders appeared resolved, risking premature judgment and requiring designers to re-evaluate their validity more critically. In this way, CreAIte inadvertently introduced inefficiencies by creating the illusion of readiness without ensuring technical soundness.

#### 8.5.2.3. Drift Happens: Losing Brand Identity Across Iterations

Another key limitation of CreAIte was its inability to consistently preserve branding and detail fidelity across iterative generations. While the tool excelled at generating rapid visual outputs, it often failed to maintain essential brand elements such as logos, stitching, and signature material textures, features critical to Bugaboo’s visual identity.

In the AI Bag Design session, Victoria noted: *“It’s completely getting rid of the Bugaboo logo... that’s something we could have expected.”* This omission disrupted workflow efficiency, as designers had to manually reintroduce branding details through tools like Photoshop or CAD, undermining the speed advantages that AI was supposed to provide.

A more systemic issue emerged during iterative use. As Victoria reflected, *“The more you iterate..., the more the details appear to vanish.”* Elements like fabric stitching or material finishes were often lost or degraded over time, especially if not explicitly reinforced in each prompt. She added, *“If it wasn’t in the prompt... AI completely forgot about the stitches and everything else.”* This placed an ongoing burden on designers to maintain control through highly specific inputs.

Together, we likened this phenomenon to repeated media compression: *“It’s like when you download a YouTube video and upload it 1000 times... the quality is reduced.”* With each new AI generation, minor distortions accumulate, subtly altering textures, proportions, and other brand cues.

This gradual degradation was particularly problematic in the later stages of development, where design consistency and brand fidelity were essential. Instead of supporting

refinement, CreAItE often introduced small but compounding errors, requiring manual correction and reducing its effectiveness as a tool for structured iteration.

#### 8.5.2.4. *Too Much of a Good Thing: Over-Iteration and Decision Fatigue*

While CreAItE excelled at generating rapid and diverse design variations, this very strength also introduced a significant challenge: decision fatigue. The tool's capacity to produce endless alternatives made it difficult for designers to know when to stop. As Olivia noted, *"The challenge is knowing when to stop, AI makes it easy to keep iterating forever."*

Without clear stopping rules or selection criteria, designers risked becoming overwhelmed by the volume of options. Victoria described this dilemma: *"You get generations, generations, generations... but it was unclear... what is a good generation?"* In the absence of built-in evaluation tools, teams had to manually filter through dozens of outputs, often without clear indicators of which direction was most viable.

This lack of structure sometimes led to circular exploration. Victoria reflected on the frustrating loop that could occur: *"It's easy to get lost in the variations, and sometimes you end up back where you started."* Instead of accelerating decisions, CreAItE occasionally prolonged them by over-expanding the solution space without providing support for converging on a final direction.

In short, while CreAItE proved powerful for early-stage ideation, it also required careful moderation. Without constraints or decision frameworks, designers were prone to over-exploration, losing time and clarity in the process. To fully leverage generative AI in industrial design, teams must pair its expansive capabilities with structured workflows that guide iteration, filter results, and support confident decision-making.

### 8.6. *Technology Acceptance (TAM) Assessment of CreAItE*

To assess the acceptance and adoption potential of the CreAItE workflow, integrating PromptGPT with KREA and Midjourney, a Technology Acceptance Model (TAM) survey was conducted among the Bugaboo product development team. The entire design and development team was invited to participate, and eight respondents completed the survey. The results combined qualitative feedback and quantitative scoring across Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) (Davis, 1989). The full results can be found in Appendix D. A summary of the descriptive results is provided in Table 5.

The overall TAM score averaged 3.78 out of 5 (PU: 3.88, PEU: 3.75, BI: 3.50), indicating strong enthusiasm tempered by cautious optimism regarding implementation challenges and practical utility. Participants described CreAItE as *"exciting," "surprising,"* and *"excellent,"* appreciating its ability to generate rapid visualizations and support creative exploration. However, concerns emerged about prompt sensitivity, variability in output quality, and the conceptual nature of some results.



**Table 5.** Descriptive statistics for Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) of the TAM Survey Results for CreAIte (n = 8)

Metric	Mean	SD	Median	Min	Max
<b>PU</b>	3.88	0.89	4.00	2.00	5.00
<b>PEU</b>	3.75	0.63	3.75	3.00	5.00
<b>BI</b>	3.50	0.93	3.50	2	5

#### 8.6.1. Perceived Usefulness: Accelerating Concept Work, Especially Early

Perceived Usefulness (PU) scored highly, averaging 3.88, indicating that participants widely recognized CreAIte's ability to accelerate early-stage design work. Several highlighted its role in *"quickly visualizing new ideas"* and *"creating quick images for inspiration,"* especially valuable when brainstorming new concepts or iterating on early sketches. One participant described it as *"surprising how fast this works,"* particularly for generating style variations related to colors and materials.

Others emphasized CreAIte's potential for expanding creative exploration, seeing it as a tool that could *"divert and create many different options and variations on existing models."* There was also recognition of time savings by using CreAIte-generated images for initial visual studies, with one comment noting its value for *"changing the colors of the stroller."*

However, some reservations surfaced regarding the quality of outputs for later-stage or more production-focused needs. One participant commented that while the tool was promising, they were *"not sure how useful it would be if the output remains too conceptual."* These reflections suggest that while CreAIte is seen as highly useful for early ideation, broader adoption into later design phases will depend on improving the precision and realism of generated visuals.

#### 8.6.2. Perceived Ease of Use: Intuitive, but Prompt-Sensitive

The Perceived Ease of Use (PEU) dimension averaged 3.75, reflecting general confidence in CreAIte's accessibility. Several participants praised the intuitive nature of the workflow, describing how they could *"quickly iterate and test ideas"* without needing complex setup or specialized training. Others noted the appeal of moving *"from sketch or basic not-yet good-looking 3D model to nice render"* with minimal effort.

Despite these positive impressions, concerns about prompt sensitivity were frequently mentioned. Participants observed that achieving good results required careful prompting, *"good prompts"* were critical to steer the outputs toward usable directions.

Participants with less prompting experience expressed lower ease-of-use ratings, suggesting that while the interface is straightforward, effective use of the tool would benefit from prompting guidance and structured examples tailored to different design contexts.

### 8.6.3. Behavioral Intention: Cautious Enthusiasm to Adopt

Behavioral Intention (BI) scores averaged 3.50, indicating moderate to strong intent to integrate CreAIte into regular workflows. Participants saw particular value in using the tool for early-stage brainstorming, with one noting that it was especially helpful for *"quickly visualizing new product ideas"* and for *"getting inspired by various outcomes"* early in the design process.

However, some participants expressed caution. While enthusiasm for rapid ideation was high, doubts remained about regularly using CreAIte for more refined deliverables. As one participant explained, while they saw clear potential, their adoption would depend on *"improvements in quality,"* particularly regarding the realism and precision of outputs required for later development phases.

These responses suggest that while CreAIte fits well into the exploratory and concept generation phases, wider integration into the full design process will rely on continued improvements to output fidelity and reliability.

### 8.6.4. What this Means: Strong Early Potential, Dependent on Quality and Fit

The TAM results for CreAIte reveal strong optimism about its role in accelerating early-stage ideation and expanding creative exploration within Bugaboo's design workflows. Participants appreciated the tool's ability to deliver visual inspiration rapidly, diversify design directions, and enhance brainstorming activities.

Nonetheless, moderate caution, reflected in concerns over visual quality, prompt sensitivity, and fit for later-stage design tasks, indicates that CreAIte's broader adoption will depend on further refinement of output consistency, targeted training, and examples demonstrating tangible integration into varied design processes.

## 8.7. Conclusion: CreAIte as a Provocation Engine for Visual Exploration

CreAIte was developed to address a fundamental tension in Bugaboo's design practice: the need to explore ideas quickly and broadly at early stages, without being slowed by the demands of polish and fidelity that traditional tools impose. By integrating PromptGPT, KREA, and Midjourney into a cohesive workflow, CreAIte aimed to accelerate iteration, expand visual exploration, and streamline collaboration during the Propose phase of the Frame–Propose–Evaluate (FPE) model.

In real-world use, that ambition is largely held. Designers could now generate a gallery of concept variations in minutes. Victoria's accessory mood boards transformed into CMF proposals ready for supplier discussions, while Olivia reflected on the dramatic shift in pace: *"Doing this in AI takes one minute. Manually, it took hours."* The workflow's speed and breadth helped reduce creative bottlenecks, encouraged divergent thinking, and enabled early cross-functional alignment through clear visual conversation starters.

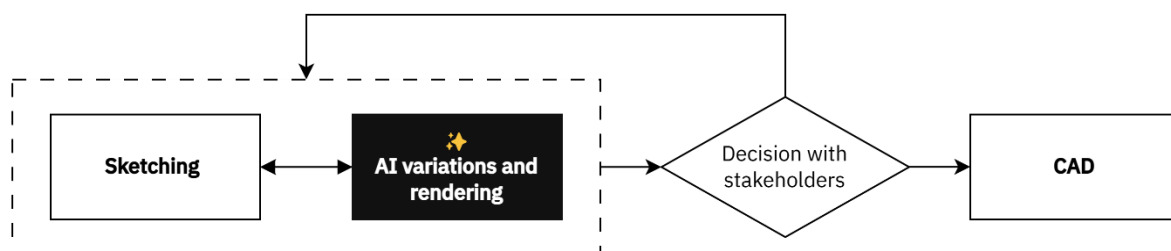
These advantages were most pronounced in ambiguous or exploratory phases. Designers could quickly generate high-fidelity visuals, test aesthetic alternatives, and externalize speculative ideas without committing prematurely. CreAItE reshaped early-stage representation action by embedding a more fluid, feedback-driven rhythm into the design process, supporting exploration without displacing core creative judgment.

Yet, the same abundance revealed CreAItE's boundaries. While the tools excelled at provoking new directions, helping teams see *"what else might be"*, they struggled when precision, manufacturability, and brand fidelity became non-negotiable. Subtle tweaks to stroller structures in KREA often triggered unintended geometry changes; Midjourney's masking could recover some control, but brand elements like stitching, logos, or material nuance tended to drift without deliberate reinforcement at each generation. As Victoria observed, *"The more you know what you want, the less useful it is."*

The sheer volume of AI outputs also introduced decision fatigue. Without clear stopping rules or evaluation frameworks, designers risked over-iteration, sometimes circling back to their starting points after sifting through dozens of variations. Olivia captured this challenge succinctly: *"The challenge is knowing when to stop."*

These experiences clarified CreAItE's place in the process: not as a tool for precise refinement, but as a provocation engine, ideal for expanding the solution space and enabling faster more exploratory visualization. As shown in Figure 28, its strength lies in bridging sketching and CAD.

Importantly, designers found that CreAItE's effectiveness improved when used deliberately: structured prompting, strategic masking, reference-image control, and early exit points helped ensure that the workflow remained an accelerator, not a distraction. As Victoria described it, CreAItE became *"a bridge to traditional tools,"* allowing teams to move from rough ideation to focused development more fluidly and confidently.



**Figure 28.** CreAItE enables a fast, iterative loop between sketching and AI-generated variations, accelerating early exploration before stakeholder alignment and CAD. This novel workflow expands creative possibilities without replacing traditional tools.

Ultimately, CreAItE's value lies not just in the images it generates but also in how it reshapes the pace of early-stage design, enabling faster momentum, fewer bottlenecks, and a more iterative path from sketch to concept.

## 9. AI for Evaluation: Exploring the Potential of RulesGPT to Augment Reflective Action

### 9.1. Introduction: RulesGPT and Compliance Checks at Bugaboo

This chapter examines the development, application, and evaluation of RulesGPT, a custom generative AI tool designed to augment compliance checking and support Reflective Action during early-stage product development at Bugaboo.

Navigating compliance is an integral but often disruptive part of the design process. Designers must verify product concepts against complex regulatory frameworks early, yet accessing, interpreting, and applying requirements typically demands navigating fragmented documents, slowing creative momentum. At Bugaboo, RulesGPT was developed to turn this friction into an opportunity: to bring real-time, verifiable regulatory guidance directly into design workflows, reducing dependency on specialists for preliminary checks and embedding compliance faster into decision-making.

Built as an AI-driven compliance assistant, RulesGPT integrates a structured regulatory database with ChatGPT's conversational and context-tracking capabilities. It was designed to retrieve verbatim clauses, trace citations to source documents, and translate dense legal language into actionable summaries, enabling designers to independently access critical regulatory information without breaking workflow continuity. Rather than replacing expert validation, RulesGPT was conceived as a first-line assistant for accelerating compliance reflection during the Evaluate phase of the Frame–Propose–Evaluate (FPE) cycle.

Through research sessions with four Bugaboo designers and developers, spanning innovation, product development, and engineering, RulesGPT was tested across real-world compliance challenges: from ergonomic checks and mechanical force verification to chemical safety and multi-market regulation alignment. Observations from these sessions, along with reflective interviews and benchmarking exercises, provided a grounded evaluation of RulesGPT's performance.

Findings revealed benefits. Designers accessed compliance information faster, integrated regulatory checks faster in their processes, and gained greater independence in regulatory questions. However, challenges surfaced: the system's effectiveness was sensitive to query phrasing, inconsistencies occasionally appeared across similar prompts, and speculative outputs under low-confidence conditions reinforced the need for critical human oversight.

The sections that follow detail these findings. Section 9.2 outlines the participant designers and session contexts; Section 9.3 introduces the RulesGPT workflow and technical logic; Section 9.4 reflects on interface and development refinements; Section 9.5 explores RulesGPT's impact on reflective action; and Section 9.6 presents a Technology Acceptance Model (TAM) assessment, concluding in Section 9.7.

## 9.2. Participants and Research Sessions

Four Bugaboo designers and product developers tested RulesGPT during live projects to evaluate its effectiveness in verifying compliance requirements. Their diverse backgrounds provided different perspectives on the tool's performance.

- **Liam**, Product Designer, tested RulesGPT's ability to retrieve and interpret stroller backrest angle regulations, focusing on design-stage ergonomic compliance checks.
- **David**, Senior Product Developer, explored how RulesGPT could identify and clarify operational force constraints in reclining mechanisms, followed by a reflection on its performance.
- **Alex**, Director of Product Innovation, used RulesGPT for ad-hoc compliance checks, verifying bassinet stability under Canadian regulations and heavy-metal migration limits for European and U.S. markets. He also evaluated the tool's accuracy and cross-regional relevance.
- **William**, Product Developer, assessed compliance with pinching and shearing requirements for a new frame-folding mechanism using RulesGPT.

*For confidentiality reasons, the detailed session contents and outcomes have been omitted, and the names have been replaced with pseudonyms.*

## 9.3 Study Material: How RulesGPT Supports Real-Time Compliance

RulesGPT is a generative AI compliance assistant developed to help Bugaboo's design teams navigate complex regulations efficiently and accurately. Unlike traditional methods that require manually searching through multiple documents, RulesGPT delivers structured, traceable compliance guidance directly within the design workflow. By combining a regulatory database with a large language model and leveraging ChatGPT's source and context memory, it ensures every response remains accurate, transparent, and verifiable throughout the user interaction (see Figure 29 for an overview of the system's logic)..

### 9.3.1. How It Works: Step-by-Step Logic Behind RulesGPT

RulesGPT is designed to deliver precise, regulation-based answers by combining structured logic with conversational context. Rather than relying on approximations, it grounds each response in verifiable compliance data, prioritizing traceability, accuracy, and transparency. Upon receiving a question, RulesGPT reframes it using regulatory language, identifies relevant keywords, and maps them to compliance categories. This improves search precision and ensures retrieval of only authoritative, context-appropriate information.

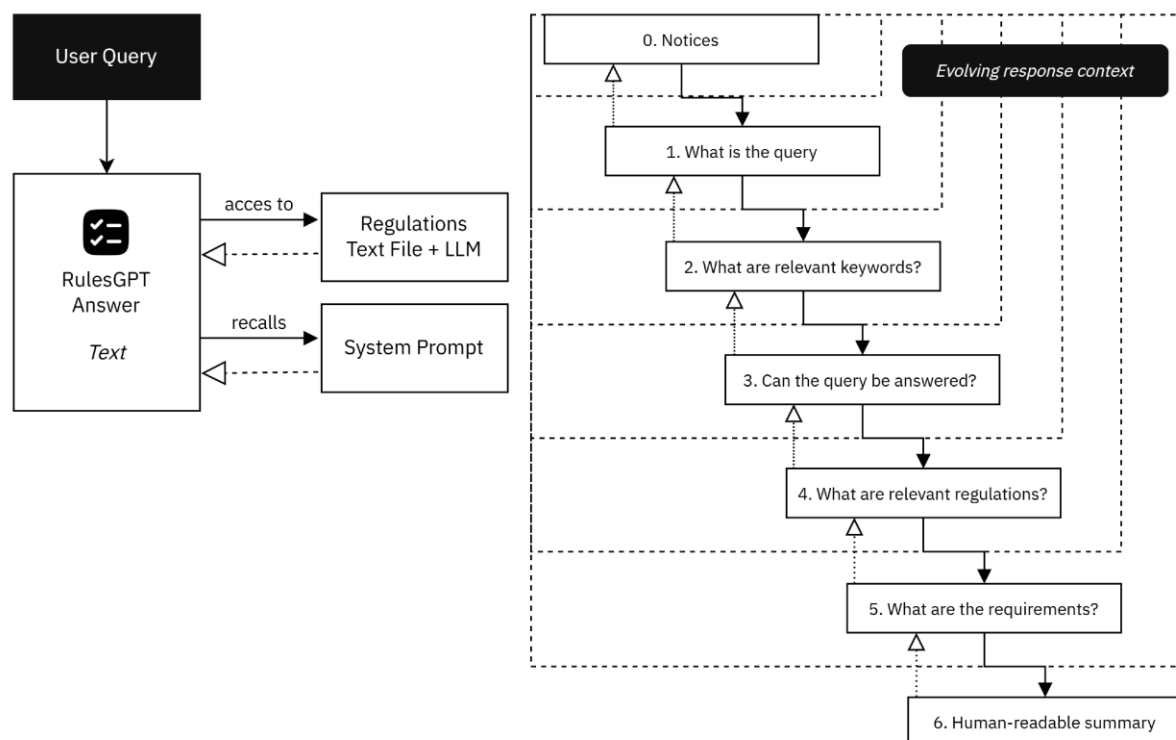
If a direct regulatory match is found, the system provides the applicable standard (e.g., EN 1888-1:2018 + A1:2022), clause number, sheet title, and a direct source link. It also includes the exact requirement text and associated test methods, eliminating interpretation errors and ensuring every response is audit-ready. When no exact match exists, RulesGPT

clearly identifies the gap and suggests the nearest applicable alternatives, avoiding misleading or assumed answers.

To support design clarity, the system generates human-readable summaries that translate complex legal language into actionable guidance without losing nuance. A real-world example of this functionality in action is illustrated in Figure 30, where RulesGPT responds to a seat design query by retrieving and summarizing relevant entrapment standards for both EU and US regulations.

### 9.3.2. Building Trust: RulesGPT's System for Traceability and Transparency

Traceability is central to RulesGPT. Every response can be verified through strict citation protocols, including clause numbers, document titles, and direct regulatory links. Its structured format ensures consistent output, reduces ambiguity, and builds user confidence. By critically assessing each query and avoiding speculative responses, RulesGPT promotes clarity and accountability. This transparent approach makes compliance evaluation easier and embeds compliance directly into the creative process.



**Figure 29.** This diagram illustrates how RulesGPT processes compliance-related questions from start to finish. The left block shows how the system interprets user queries, accessing regulatory texts and prompts to generate accurate responses. The right-hand side outlines the step-by-step reasoning—starting with query interpretation and keyword mapping, followed by answerability checks, regulation retrieval, requirement extraction, and ending with a human-readable summary.

## BGB PromptGPT || Prompt Generator & CMF Aide

By community builder X

This Bugaboo GPT can transform product images or descriptions into detailed Midjourney/KREA prompts. Share a description or upload an image to get started! ⚠️ This GPT may make mistakes. Avoid sharing sensitive data. MFA must be enabled on your OpenAI account to use ChatGPT for Bugaboo purposes. ⚠️

⚠️ How can I responsibly use PromptGPT and...

Tell me what you can do, PromptGPT. Be exact and brief.

Make a prompt for this stroller, here's a description: A...

Edit the prompt for this bag and turn it brown: A premiu...

Ask anything

+

🔍 🔊

I am designing this seat frame and I am worried about the gap between the seat and the backrest, can you pull up entrapment regulations for Europe and the US?

### 0. Notices

At Bugaboo, we use terms like "bassinet" and "carry cot" interchangeably, but they are different products. Check the exact product name to make sure you find the right requirements.

Disclaimer: RulesGPT may sometimes paraphrase information rather than provide verbatim quotes, even if it appears as a direct quote. Double-check when needed.

### 1. What is the query?

The user is designing a seat frame and is concerned about the potential for entrapment hazards between the seat and the backrest. They want to know the entrapment hazards for the United States.

### 2. What are relevant text requirement or test method keywords?

Query converted to related text requirement keywords: entrapment, finger entrapment, openings, seat-back gap, protected

### 3. Can the exact query be answered? How about with the keyword

Yes, I found highly relevant entrapment regulations for the EU and US regarding bounded openings in seat units, including the backrest area.

### 4. What are relevant regulations and clauses for this query?

- Europe: EN 1888-1:2018 + A1:2022, Requirement clause 8.2.1.1
- United States: ASTM F833-21, Requirement clause 5.6

From sheet titled: 9. ENTRAPMENT HAZARDS OF FINGERS

### Europe (EN 1888-1:2018 + A1:2022, Requirement clause 8.2.1.1)

#### 8.2.1 Holes and openings – 8.2.1.1 Requirements

When testing in accordance with 8.2.1.2 there shall be no completely bounded openings in rigid materials within the protected volume that let the 7 mm probe go through unless the depth of penetration is less than 10 mm or unless the shape assessment probe enters. This requirement is not applicable to the restraint system. The size of the holes in mesh within the protected volume shall be less than 7 mm when measured in accordance with 8.2.1.2. (Source: Worldwide compliance requirements strollers (Sharepoint), EU, EN 1888-1:2018 + A1:2022, Requirement clause 8.2.1.1)

### United States (ASTM F833-21, Requirement clause 5.6)

#### 5.6 Openings

Holes or slots that extend entirely through a wall section of any rigid material less than 0.375 in. (9.53 mm) thick and admit a 0.210-in. (5.33-mm) diameter rod shall also admit a 0.375-in. (9.53-mm) diameter rod. Holes or slots that are between 0.210 in. and 0.375 in. in diameter and have a wall thickness of less than 0.375 in. but are limited in depth to 0.375 in. maximum by another rigid surface shall be permissible. The product shall be evaluated in all manufacturer's recommended use positions. (Source: Worldwide compliance requirements strollers (Sharepoint), US, ASTM F833-21, Requirement clause 5.6)

### 6. Human-readable summary

In the EU, gaps in rigid components like the seat-to-backrest area must not allow a 7 mm probe to enter more than 10 mm deep unless the shape probe can also pass. Mesh must have holes smaller than 7 mm. These gaps are tested within the protected volume, which excludes space behind the backrest.

In the US, any hole that a 5.33 mm rod can pass through must also admit a 9.53 mm rod, unless the depth of the hole is shallow (less than 9.53 mm). This ensures that a child's finger cannot get trapped in narrow, deep holes.

**Figure 30.** This collage shows how RulesGPT handles a practical design question about seat-to-backrest gaps by retrieving relevant entrapment regulations for both Europe and the US. The system interprets the concern, maps it to test-relevant keywords, and provides regulatory excerpts alongside a human-readable summary, demonstrating RulesGPT's ability to deliver structured compliance guidance that supports design decisions.

## 9.4. Developing RulesGPT: Interface and Design Rationale

RulesGPT began as a generative AI tool to embed compliance awareness into early design workflows, but initial tests at Bugaboo exposed two major flaws: inconsistent interpretation of standards and a lack of transparent sourcing. These issues undermined trust and limited practical use. Through iterative testing and practitioner feedback, the system was refined to address these gaps. It now retrieves only verbatim regulatory text, includes full citations for traceability, follows a standardized six-step format, and presents human-readable summaries. Crucially, it can also acknowledge when no matching regulation is found. These improvements have transformed RulesGPT into a reliable compliance search engine integrated into daily design practice.

### 9.4.1. From Fluctuation to Fidelity: Anchoring Outputs in Verbatim Sources

One of the most pressing early issues was variability in RulesGPT's responses, especially regarding numeric values and clause-specific guidance. Designers encountered inconsistencies in repeated queries, undermining confidence in the tool's reliability. Interventions included restricting outputs to verbatim quotes from regulatory documents, enforcing alignment with structured clause data rather than generative approximations, and ensuring that identical prompts return consistent results across sessions.

As David noted during testing, *"At first, it confidently said 50 Newtons was the required force, but then it changed to 45–70 Newtons."* These fluctuations were eliminated by anchoring the tool's logic to static, verified source material, transforming it from an interpretive assistant to a fact-based retrieval engine.

### 9.4.2. Building Trust: Transparent Citations and Traceable Sources

Another early barrier was the tool's failure to clearly attribute its answers to specific regulations or documents. Users were left to manually verify claims, wasting time and reducing trust. To resolve this, citation standards were introduced, which meant that each output now includes the regulation name, clause number, file name, and sheet title, responses are embedded with hyperlinks to the original documents, and the context of each quote is clearly labeled (e.g., *'Entrapment Hazards of Fingers'*).

Participant Liam emphasized the need for this: *"It should explicitly say, 'this is a stroller regulation' or 'this applies to bassinets' so we can immediately see if it's relevant."* These changes increased traceability and accountability, positioning RulesGPT as a verifiable compliance tool.

### 9.4.3. Structuring for Usability: Standardized Outputs and Summaries

Users also struggled with dense, inconsistent outputs, especially when trying to quickly extract key insights. To improve usability, a six-part structured response format was introduced. Enhancements included a standardized structure applied across all outputs for



ease of scanning, human-readable summaries that translate regulatory text into actionable design guidance, and formatting to facilitate comparison and reusability across teams.

This format ensures that both technical experts and non-specialists can quickly understand and apply regulatory insights, without needing to decode legal language.

#### *9.4.4. Acknowledging Gaps: Teaching the System to Say “No”*

Perhaps one of the most important refinements was enabling RulesGPT to explicitly acknowledge when no matching regulation could be found. Previously, the system would attempt speculative responses, which risked misinterpretation and false confidence. To mitigate this, the system now states clearly when data is missing (e.g., “No, I could not find a dedicated 'jogger stroller' section in the compliance files.”), prompting users to seek manual validation when necessary.

By acknowledging its own boundaries, RulesGPT reduces the risk of false assumptions and reinforces user trust in its outputs.

### *9.5. Reflection and Learnings on AI-Augmented Reflective Action*

This chapter explored how RulesGPT, a generative AI tool for compliance support, impacted the way Bugaboo designers engaged with regulatory constraints during product development. It reveals how the tool streamlined document retrieval, improved early integration of compliance into the design process, and supported independent inquiry through structured, accessible summaries. However, the tool's introduction also surfaced important challenges, particularly around response consistency and overconfidence in uncertain answers. Together, these insights offer a balanced view of RulesGPT's role as an AI-enhanced compliance assistant: powerful in accelerating workflows and fostering autonomy, but still dependent on expert oversight and continued refinement for trust and accuracy.

#### *9.5.1 What Worked: Strengths of RulesGPT in Accelerating Compliance Research*

RulesGPT demonstrated clear strengths in making regulatory information more accessible, interpretable, and embedded in daily design practice. Rather than treating compliance as an afterthought or a specialist-only concern, the tool enabled faster integration of constraints, faster information retrieval, and greater self-sufficiency for designers. These capabilities positioned RulesGPT as a valuable first-line assistant, supporting both speed and understanding in regulated design contexts.

##### *9.5.1.1. Speeding Up the Search: From Document Chasing to Instant Access*

One of RulesGPT's clearest benefits was its ability to streamline access to compliance information, traditionally a slow and manual process. Before AI integration, retrieving relevant regulations meant navigating SharePoint folders, verifying document versions, and checking across multiple sources. As Alex described: “First, you have to search in SharePoint, where was it again? Then you find it, then you have to find the right version, then

*open the most recent one, and then you have 27 different documents.”* This cumbersome process not only consumed valuable time but also introduced friction into fast-paced design cycles.

RulesGPT replaced this workflow with near-instant answers, providing relevant excerpts, clause numbers, and summaries within seconds. David highlighted the difference in turnaround: *“Normally, you ask someone, and then you have to wait. Now the answer is available within a minute.”*

By drastically reducing the time spent locating regulatory content, RulesGPT freed up designers and engineers to focus on implementation rather than information retrieval, making compliance less of a bottleneck in the design process.

#### 9.5.1.2. From Afterthought to Input: Bringing Compliance into Early Design

RulesGPT has enhanced the way compliance is integrated into the design workflow, transforming it from a post-design verification step to a more proactive approach. This shift has led to better regulatory foresight and reduced last-minute design changes due to compliance failures.

- **Better Integration into Workflow:** AI was seen as a beneficial supplement to existing compliance processes, but not a replacement for expert validation. By providing quick access to relevant regulations, designers can now check compliance constraints faster in the development process. As Alex noted, *“It doesn’t replace final compliance checks, but it makes it easier to take into consideration throughout the design process.”* This integration has the potential to help reduce surprises later in development and allow teams to address regulatory needs without disrupting momentum.
- **Facilitating Knowledge Transfer:** The ability to query RulesGPT for regulatory information without needing deep expertise in compliance has made it a useful tool for understanding regulations and communication purposes.
- **Reducing Over-Reliance on Compliance Experts for Routine Queries:** Previously, minor regulatory questions would require direct input from compliance specialists, leading to bottlenecks. David described the typical workaround: *“Sometimes you think, I’ll just send an email to the expert ... this is going to take a long time if I want to find it myself.”* With RulesGPT, routine questions could be resolved independently, allowing experts to focus on higher-stakes issues and reducing communication bottlenecks.

#### 9.5.1.3. From Legalese to Action: Structured Summaries for Designers

RulesGPT’s value extends beyond search, it transforms dense regulatory documents into clear, actionable summaries. This interpretive layer proved especially useful for designers, who often need quick clarity on specific constraints without diving into legal detail.

- **Making Regulations Actionable**

Instead of copying raw text, RulesGPT presents structured, human-readable outputs. As Alex and David emphasized: *“This program is able to translate regulatory texts into something consumers and also we designers understand.”* This helped designers move from uncertainty to action, integrating regulatory constraints early without needing deep expertise.

- **Supporting Independent Inquiry**

Designers previously relied on compliance specialists for interpretation. With RulesGPT, common questions could now be answered independently. As Alex put it: *“You’re walking around with a regulatory question... now you can just quickly ask it yourself.”* This reduced friction in the design process and supported more informed decision-making.

By converting technical text into design-relevant guidance, RulesGPT ensured that compliance was not only accessible but usable at every stage of development.

### 9.5.2. *The Learning Moments: When RulesGPT Fell Short*

While RulesGPT proved effective in accelerating compliance checks, its integration revealed important challenges around response consistency and trust. These limitations highlight the need for clearer confidence signaling and more systematic output formatting to ensure the tool remains a reliable support system in regulated design workflows.

#### 9.5.2.1. *When Similar Questions Yield Different Answers: The Consistency Challenge*

Consistency in AI-generated compliance responses is critical for trust. Users observed that slightly varied input phrasing sometimes led to different interpretations, creating a risk of inconsistent compliance application. While RulesGPT has improved in acknowledging uncertainty, ensuring systematic formulation of outputs remains a priority for its reliability in compliance workflows. After all, receiving different formulations on exactly the same query can feel uncertain. Implementing Retrieval-Augmented Generation (RAG) could further mitigate this issue.

#### 9.5.2.2. *When AI Doesn’t Know But Answers Anyway*

Another critical issue raised was that the AI always provides an answer, even when uncertain. Participants noted that RulesGPT consistently responded, even with low confidence, potentially leading to misinterpretation of regulatory requirements. As David observed, *“It always gives an answer, even when it doesn’t know. That’s actually a bit scary.”* In response, RulesGPT was refined to include disclaimers when confidence is low, such as stating “Not exactly” or flagging ambiguity. *“Now it actually says ‘No, not exactly,’ and that’s an improvement,”* David added. This marked a shift in how the tool was perceived: not as a final authority but as a first-line assistant. It was valuable for quick checks but still reliant on expert validation for final decisions.

## 9.6. Technology Acceptance (TAM) Assessment of RulesGPT

To evaluate acceptance and integration potential for RulesGPT among Bugaboo's designers and product developers, a Technology Acceptance Model (TAM) survey was administered. The entire design and development team was invited to participate, and eight respondents completed the survey. The assessment measured perceptions across three dimensions: Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) (Davis, 1989). The full results can be found in Appendix D. A summary of the descriptive results is provided in Table 6.

RulesGPT received an overall average TAM score of 3.81 out of 5 (PU: 3.63, PEU: 3.97, BI: 3.88), reflecting strong enthusiasm for its role in early compliance research, alongside practical reservations about its scope, reliability, and role specificity. Participants highlighted RulesGPT's strengths in enabling faster compliance information retrieval, reducing manual document navigation, and supporting early-stage risk assessments. However, concerns remained regarding the completeness of sources, the role of expert judgment, and the tool's broader applicability across diverse roles.

**Table 6.** Descriptive statistics for Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Behavioral Intention to Use (BI) of the TAM Survey Results for RulesGPT ( $n = 8$ )

Metric	Mean	SD	Median	Min	Max
PU	3.63	1.06	3.75	2.00	5.00
PEU	3.97	0.73	4.00	3.00	5.00
BI	3.88	0.99	4.00	2	5

### 9.6.1. Perceived Usefulness: Fast, Focused, but Role-Dependent

Perceived Usefulness (PU) averaged 3.63 out of 5, suggesting that participants generally viewed RulesGPT as a helpful addition for early compliance checks. Several participants praised the tool for making it *"easy to get all requirements on certain topics together"* and for providing *"nice first feedback"* when brainstorming compliance-related issues. Others emphasized its strength in *"quickly looking up requirements, especially across multi-region standards,"* highlighting its value in fast-moving design phases where regulatory coverage must be established early.

Participants particularly valued the ability to search quickly within extensive compliance documentation, making difficult-to-read standards more accessible during concept development. However, perceived usefulness varied significantly depending on job role. Some participants explicitly noted that while RulesGPT was *"very interesting,"* it was *"not relevant"* for their day-to-day tasks, particularly among those whose roles are less compliance-focused.

### 9.6.2. Perceived Ease of Use: Intuitive but Needs Further Source Integration

Perceived Ease of Use (PEU) averaged 3.97 out of 5, reflecting widespread agreement that RulesGPT is easy to learn and operate. Participants described the tool as *"easy to find things"* and appreciated the ability to *"quickly search and find requirements"* without needing extensive training. Several noted that RulesGPT made compliance topics more manageable and more accessible, particularly when conducting early-stage assessments.

### 9.6.3. Behavioral Intention: Strong Interest, Shaped by Scope and Fit

Behavioral Intention (BI) scored highest among the three TAM dimensions, averaging 3.88 out of 5. Many participants expressed clear willingness to integrate RulesGPT into their regular workflows for early compliance verifications, finding it a valuable way to rapidly address initial questions and ensure comprehensive oversight. One participant emphasized the *"low threshold to check compliance requirements,"* framing RulesGPT as a practical, low-friction starting point for regulatory inquiries.

Nevertheless, participants also pointed out that the tool's reliance on simplified document summaries rather than original regulatory sources limited its depth. As one participant observed, while it was useful for *"first checks,"* the absence of full regulatory texts meant that detailed legal judgment or deeper regulatory nuance still required consulting in-house experts: it could not *"replace our in-house experts,"* especially in cases where nuanced interpretation across changing standards was required.

### 9.6.4. What This Means: A Valuable Starting Point, With Room to Grow

The TAM assessment of RulesGPT reflects strong enthusiasm tempered by constructive feedback on its practical utility, role-specific relevance, and technical limitations. Participants highly value its ability to support early-stage regulatory assessments, enable rapid information retrieval, and aid initial compliance exploration, recognizing significant time-saving benefits and broad oversight.

However, they also noted key limitations that could hinder broader adoption, particularly the need for greater precision and for better integration with original regulatory documents beyond internal summaries and more explicit demonstrations of value tailored to different organizational roles.

## 9.7. Conclusion: RulesGPT as Embedded Compliance for Reflection

RulesGPT demonstrated that AI can meaningfully augment reflective action in design by embedding regulatory awareness directly into the creative process. RulesGPT reframed compliance as a more proactive, consultative component of everyday design decision-making. Its structured retrieval of verbatim clauses, transparent citations, and human-readable summaries allowed designers to access critical regulatory knowledge without disrupting workflow continuity, supporting more autonomous, informed, and timely compliance checks.

Across multiple live projects, RulesGPT proved most effective in addressing routine regulatory questions and accelerating document retrieval, allowing teams to more easily shift from reactive to anticipatory compliance practices. By reducing reliance on compliance experts for preliminary inquiries, the tool empowered designers to engage with legal constraints independently and more quickly in the process. Participants valued this accessibility, noting that compliance now feels like a more manageable design parameter woven into their ideation and prototyping activities.

However, the research also highlighted essential limitations. Early iterations of RulesGPT suffered from interpretive inconsistencies and a tendency to provide speculative answers regardless of confidence level, risks that could undermine trust in high-stakes regulatory contexts. Through system refinements, including the ability to acknowledge ambiguity, enforce strict citation formatting, and apply consistent response structures, RulesGPT evolved into a reliable compliance assistant. Still, its role is best understood as a support mechanism, not a substitute for expert validation. Complex, edge-case, or cross-jurisdictional scenarios continue to require legal oversight and human judgment.

In conclusion, RulesGPT offered a glimpse into how AI can bridge the divide between legal rigor and design agility, not by replacing expertise but by making it more available, interpretable, and actionable. To fully realize this potential, ongoing development must focus on strengthening retrieval accuracy, response transparency, and user confidence, ensuring that RulesGPT remains a trustworthy partner in regulated design workflows.

## 10. Formalization of Learning: From Tools to Transformation

### *10.1. Introduction: Embedding AI into Design Culture*

This final chapter of the thesis shifts from practical experimentation to strategic reflection. After testing generative AI tools like InsightGPT, CreAIte, and RulesGPT within live product development contexts, the focus now turns to the broader implications for Bugaboo. In ADR terms, this corresponds to the formalization of the learning stage, where specific findings are distilled into generalizable insights. The following sections synthesize key learnings from the pilot phase (Section 10.2), distill overarching design principles, and introduce a roadmap (10.3), developed in response to internal discussions at Bugaboo, for embedding generative AI across the company, finally concluding the thesis in Section 10.4. This transition, from tools to transformation, marks the beginning of a long-term conversation about what AI should do at Bugaboo and how the organization can stay both critical and creative in its approach.

### *10.2. Overall Observations: AI Reshapes Design Rhythm*

The work presented in this thesis did not begin with the assumption that AI would disrupt or replace the foundational principles of design at Bugaboo. Instead, the research sought to understand how these technologies might be integrated into existing rhythms, namely, those structured around the Frame–Propose–Evaluate (FPE) model. In this regard, the findings indicate that generative AI did not alter the structure of design activity, but rather intensified and redistributed certain aspects of it.

Three generative tools were integrated, each aligned with a different FPE phase and aimed at supporting uncertainty reduction actions. InsightGPT was applied in the Frame phase, accelerating the synthesis of user research and persona development. By organizing insights rapidly, it helped designers in performing information action: structuring knowledge more quickly and simulating user personas, thereby supporting framing (without eliminating the need for validation). CreAIte entered during the Propose phase, expanding the conceptual space through rapid visual generation. It supported representation actions by making the solution space more visible early in the process. RulesGPT was incorporated into the Evaluate phase, allowing quick access to relevant compliance and regulatory information. It supported reflective actions by prompting early consideration of feasibility and compliance, allowing constraints to be surfaced while changes were still easy to make.

Each tool thus complemented a phase of the FPE model, enabling faster iteration cycles and more overlapping loops of framing, proposing, and evaluating. Together, these tools supported uncertainty reduction actions at each stage without eliminating uncertainty itself. They enabled teams to frame, propose, and evaluate more rapidly and iteratively,

encouraging a faster rhythm of partial clarification, exploration, and reflection. However, they also reinforced the need for judgment, validation mechanisms, and convergence.

As a result of AI integration, designers reported spending less time on manual synthesis, visualizing, and regulatory research. Instead, effort shifted toward interpretation, prompt refinement, and stakeholder alignment. This did not reduce design complexity but altered its distribution. AI tools allowed ambiguity to be addressed earlier, making the FPE loops faster and more fluid without simplifying the underlying challenges.

Despite these benefits, AI tools also introduced challenges that demanded deliberate management. Several patterns were observed across the interventions. The volume of outputs from InsightGPT and CreAIte frequently exceeded the teams' ability to interpret and prioritize them effectively. Rather than advancing decision-making, the abundance of options occasionally led to stagnation. This made convergence strategies, such as editorial filtering, predefined stopping criteria, and team-imposed constraints, essential. In these moments, the limitations of AI became evident: while capable of supporting generative expansion, the tools lacked mechanisms for guided selection, a responsibility that remained with human designers.

Moreover, without deliberate direction, they reproduced dominant patterns embedded in their training data. InsightGPT defaulted to mainstream user narratives, and CreAIte often generated stylistic variants within conventional norms. Innovation, therefore, remained contingent on the designer's ability to reframe prompts and challenge defaults. The AI's outputs reflected the assumptions it was given, not independent critical reasoning.

In addition, none of the AI tools replaced empirical validation. InsightGPT's synthesized personas were not substitutes for direct user interaction. CreAIte's visual outputs required evaluation against brand identity, feasibility, and user desirability. RulesGPT's clause interpretations were starting points, not definitive judgments. These findings reaffirmed that AI could enhance design breadth, but depth remained reliant on human oversight, real-world testing, and embodied experience.

Importantly, the integration of AI both introduced new competencies and highlighted the critical importance of existing ones. Skills such as prompt literacy, editorial judgment, and iterative validation became central to navigating AI-augmented design work. In the sessions, designers shifted to orchestrating and interpreting machine-assisted outcomes.

In conclusion, generative AI, when integrated with intent and critical oversight, does not redefine design but reshapes its tempo and cognitive structure. It supports faster framing and broader exploration while preserving the evaluative rigor central to responsible product development. This section lays the foundation for the principles and strategic implications that follow in subsequent sections.



### *10.3. Principles for Using Generative AI in Design Practice*

Although InsightGPT, CreAIte, and RulesGPT were designed to serve distinct phases of the design process, framing, proposing, and evaluating, respectively, their practical use at Bugaboo revealed consistent patterns of interaction, limitation, and opportunity. These patterns point to foundational principles that cut across individual tools and design phases.

#### *10.3.1. AI as a Provocation Engine, Not a Replacement*

Each tool delivered value not by producing final answers but by stimulating new lines of thinking. InsightGPT helped designers question assumptions and rapidly test emerging hypotheses. CreAIte introduced novel aesthetic directions and sped up rendering. RulesGPT exposed regulatory constraints early, enabling reconsideration of feasibility at the concept stage. In all cases, AI extended the breadth of exploration but not the depth of judgment. It accelerated iteration, surfaced alternatives, and sparked internal discussion, particularly useful under time pressure or cognitive inertia. However, outputs never stood alone. Human expertise remained essential to interpret nuance, evaluate trade-offs, and decide which ideas were viable. Generative AI proved most powerful when treated as a provocation engine, an initiator of exploration, not a substitute for design authorship. As such, it can be argued that the value of AI lies mostly in its use at the early stages of design and the proposition of “*use AI early.*”

#### *10.3.2. Prompting Is the New Design Literacy*

Across all the tools, the quality of input prompts heavily determined the quality of AI output. Whether asking InsightGPT to uncover user pain points, guiding CreAIte to stay within brand language, or querying RulesGPT for regulation clauses, clear and well-scoped prompts consistently led to more relevant results. Vague or overly broad queries, by contrast, produced incoherent or generic outputs. This dynamic elevated prompting from a trivial technical step to a creative discipline in itself. Designers learned they had to balance openness with specificity, constructing queries that guide the AI without overly constraining its creativity. Over time, prompt formulation became a new form of design literacy within the team. It is essentially a form of *meta-design*: designers design the conditions of the AI’s output by carefully wording their input. Mastering this skill meant the difference between getting a banal, obvious suggestion versus an unexpected insight. Thus, prompting emerged as a way to frame and steer exploration in a meaningful direction.

#### *10.3.3. Divergence Is Easy, Convergence Needs Design*

While AI excels at generating content, it lacks an internal mechanism for selection. CreAIte, in particular, could produce an overwhelming number of plausible design variants, which made decision-making harder, not easier, and even led to decision fatigue. In other words, diverging is cheap and easy with AI, but converging on the right choice remains hard and must be guided by design expertise. The takeaway is that AI won’t tell you when to stop or which path to choose; those are design decisions. Human designers must deliberately

design their convergence process, using techniques like concept selection matrices or user feedback, to reap the benefits of AI's prolific output without getting lost in it.

#### *10.3.4. Context Still Wins: Why Judgment Can't Be Automated*

Across all tools, AI struggled to account for real-world nuance, whether physical, emotional, or contextual. InsightGPT's personas lacked the interpersonal richness of live interviews. CreAIte could render visually appealing concepts, but it had no understanding of the physical constraints or subtle ergonomics. RulesGPT provided quick summaries of regulations, but it had only a shallow notion of context; it could not interpret rules like a compliance expert would.

These limitations reaffirmed a core tenet: while AI can synthesize patterns, only humans can synthesize meaning in context. Every AI output requires anchoring in real-world practice. Design concepts still required physical prototyping and testing with users. Personas needed validation against actual user behaviors and needs. Compliance decisions ultimately had to be vetted by legal experts. In sum, the tools were excellent for generating hypotheses and first drafts, but embodied judgment, experiential knowledge, and empathy remained irreplaceable. The context-aware critique that a skilled designer or engineer provides is something AI could not replicate.

#### *10.3.5. Keep Humans in the Loop to Build Trust and Ownership*

The pilots showed that the team's trust in AI tools grew when workflows were transparent and human oversight was maintained. Designers did not expect the AI to be perfect; instead, they wanted to clearly understand *how* the AI arrived at its outputs and where its knowledge came from. For example, RulesGPT became much more trusted once it started providing references to the source regulation clauses and openly admitted when it didn't have an answer. Similarly, InsightGPT's credibility improved when designers cross-checked its synthesized insights with actual user research data and found them to be reasonable. The emerging mental model was that *AI provides a draft or a suggestion, and humans verify and finish*. This approach prevented over-reliance on the AI and kept the design team in full control of decisions. By treating AI as neither an oracle nor an autonomous agent, but rather as a junior collaborator, Bugaboo's team maintained accountability and ownership of outcomes. Clear division of roles, AI-generated and humans validated, which helped protect the integrity of the design process and final products. In practice, this meant always keeping a human in the loop, which not only ensured quality and safety but also helped team members feel ownership over AI-assisted work rather than feeling displaced by it.

Together, these principles reinforce a view of generative AI as an embedded extension of the design process. Its strength lies in augmenting reflective, human-centered workflows: accelerating early-stage exploration, surfacing relevant constraints sooner, and assisting with information synthesis. However, realizing these benefits depends on skilled

practitioners who can deliberately frame its use, critically interpret its outputs, and integrate its contributions within the broader context of design reasoning and validation.

These principles were translated into the ten core principles for using AI effectively, drawn from Bugaboo's real-world experience with InsightGPT, CreAIte, and RulesGPT.

**1. Use AI Early:** Bring AI into your process from the beginning; it is most useful when exploring ideas and not fixing problems too late. In practice, designers found that *“the more you know what you want, the less useful it is.”* In particular, CreAIte was effective at generating broad conceptual variations but lacked the precision needed to refine detailed designs, making it best suited for open-ended exploration rather than final adjustments.

**2. Ask Clear Questions, Get Clear Answers:** The better your prompt, the better the result. Be specific, as AI works only with what you provide. Designers learned this through experience: well-structured prompts in tools like InsightGPT and CreAIte yielded far more relevant results, whereas vague queries returned generic or incoherent outputs.

**3. Let AI Show Options, Not Make Decisions:** AI is great at offering many directions, but it cannot choose what is best; that is your job. For example, CreAIte could generate countless accessory design variants, but the team ultimately had to select which concept to pursue, confirming that the AI's role was to propose ideas while final decisions remained human-driven.

**4. Use AI to Think Wider:** Use it to explore a wider range of ideas quickly, but rely on your expertise when it is time to get precise or detailed. CreAIte illustrated this by enabling designers to rapidly examine diverse visual concepts and break out of early fixation, after which human judgment was applied to narrow down and refine the best options.

**5. Don't Confuse AI Speed with Truth:** Fast does not mean right; treat AI's quick insights as starting points that need to be checked, compared, and verified. For instance, RulesGPT could instantly suggest regulatory requirements, but its answers always required human interpretation and validation, demonstrating that a rapid response from the AI was not automatically a correct or context-aware one.

**6. See People, Not Just Data:** When using AI-generated personas or user insights, always humanize the output; visual aids can help keep empathy in focus, because empathy still matters. This need became clear when InsightGPT sometimes produced generic *“average user”* personas lacking nuance; designers had to infuse real-world details and empathy to ensure these AI-driven profiles truly reflected actual users.

**7. Challenge What AI Reflects:** AI mirrors what is common. If you want fresh thinking, ask it to challenge assumptions instead of just repeating them. In Bugaboo's trials, InsightGPT tended to reinforce the initial problem framing rather than question it, so researchers learned to explicitly prompt the AI to probe their assumptions – as one noted, *“the AI doesn't really challenge you unless you deliberately ask it to.”*

**8. Use AI as a Design Partner, Not a Shortcut:** Think of AI as a co-pilot; it can accelerate your work, but it still requires your judgment, taste, and direction. In practice, Bugaboo's design teams kept a human-in-the-loop approach: AI tools jump-started ideas and provided options, but designers applied their expertise to steer and finish the outcomes, confirming that true value came from co-creation rather than handing work off to the AI.

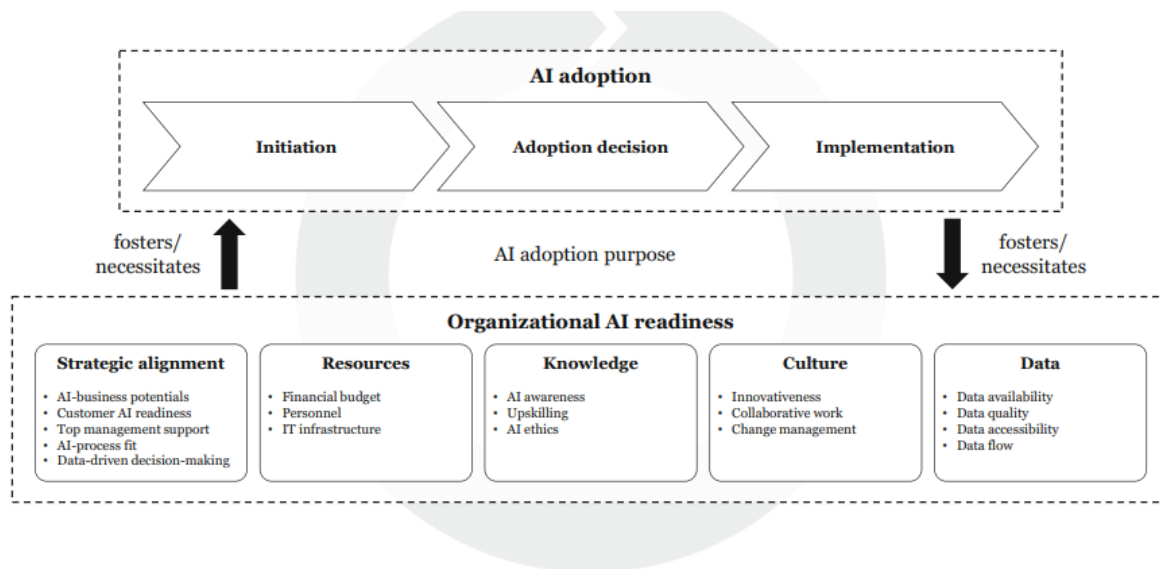
**9. Know When to Stop Iterating:** AI can keep generating content indefinitely; you must decide when to move forward. Do not get stuck in the loop. For example, CreAIte could produce an overwhelming number of design variations, so the team had to consciously impose a cut-off point and shift into decision-making mode, preventing endless AI-driven ideation from causing decision fatigue.

**10. Keep It Traceable and Transparent:** Whether it is compliance rules or persona logic, understand where the AI got its answers. Trust requires clarity. Designers only began to trust AI outputs once they could trace their origins – for instance, when RulesGPT started citing the source of its regulatory suggestions and InsightGPT's persona insights were cross-checked with real user data, the team's confidence in those AI contributions markedly improved.

#### *10.4. The Ingredients to Embedding Generative AI (Across Bugaboo)*

With the learnings from the initial generative AI pilots, InsightGPT, CreAIte, and RulesGPT at hand, a new phase begins. What initially felt like an exploratory experiment has now become a proof point for how Bugaboo could reshape its approach to new product development. However, scaling these promising prototypes across the organization requires deliberate planning. Following internal discussions with Bugaboo stakeholders, the need for a comprehensive roadmap became clear: a roadmap that addresses not only the deployment of technology but also the integration of people, processes, and organizational culture to ensure sustainable adoption. Relying solely on organic enthusiasm or ad-hoc experimentation will not suffice if Bugaboo aims to realize AI's transformative potential.

To anchor this roadmap in established research, I draw on the framework proposed by Jöhnk et al. (2021) on organizational readiness for AI adoption. They identify five interdependent dimensions that collectively determine an organization's capacity to implement AI effectively: Strategic Alignment, Resources, Knowledge, Culture, and Data. Each of these dimensions must be developed and managed to transition from isolated initiatives to systematic, enterprise-wide deployment of generative AI (Figure 31).



**Figure 31.** The model by Jöhnk et al (2021) shows how organizational AI readiness—across strategy, resources, knowledge, culture, and data—supports each phase of AI adoption, from initiation to implementation. Readiness both enables and evolves through adoption.

#### 10.4.1 Laying the Organizational Foundation: What It Takes to Scale AI at Bugaboo

Building on the foundational work of Jöhnk et al. (2021), who identify five interdependent organizational readiness dimensions- Strategic Alignment, Resources, Knowledge, Culture, and Data- this section assesses how Bugaboo can transition from localized generative AI pilots to a scalable, sustainable adoption strategy. Importantly, the deployment of AI must address not only technical capabilities but also organizational purpose and cultural fit. As observed during my internship, generative AI was introduced in an environment where *"things already worked nicely,"* raising valid questions about why such a transformation was needed beyond just the hype. This underscores the importance of establishing a deliberate foundation that connects AI to a clearly articulated need and purpose.

##### 10.4.1.1. Strategic Alignment: Make AI Serve the Mission, Not the Hype

According to Jöhnk et al. (2021), strategic alignment is a critical dimension for AI adoption. AI projects detached from business goals risk losing momentum or becoming siloed. At Bugaboo, aligning AI initiatives means honestly confronting whether workflows, which are already trusted and productive, truly benefit from AI. Is the objective to speed up iteration, inspire new design directions, or streamline regulatory compliance? Leadership must clearly define a vision where AI enhances existing strengths rather than addressing non-existent problems. This vision must be tied into strategic plans, with measurable outcomes such as reducing concept-to-market time, while reinforcing how AI supports Bugaboo's mission of delivering innovative, parent-centered juvenile products.

#### *10.4.1.2. Resources: Build the Talent, Tools, and Budgets to Support AI*

Jöhnk et al. (2021) emphasize that resource availability, both human and technological, is essential for AI readiness. At Bugaboo, scaling AI means investing in people, infrastructure, and budget. New hybrid roles such as prompt engineers and AI-fluent product managers will emerge, while upskilling current employees through modular training will be key to overcoming resistance. Infrastructure investments must address onboarding, permission management, and tool access. Early pilots revealed that confusion around “*what was allowed*” slowed progress until an “*Allowed Uses*” document, co-created with IT, empowered teams to experiment safely. On the budget side, flexible, ongoing funding must be secured for computing credits, team subscriptions, and the broader costs of adapting workflows to integrate AI tools.

#### *10.4.1.3. Knowledge: Turn Curiosity Into Confidence Through Learning Loops*

Jöhnk et al. (2021) note that employees often resist AI when they lack clarity about how it works or fear that it might displace their roles. At Bugaboo, AI must be presented as a collaborative partner rather than a replacement. Continuous learning activities such as lunch-and-learns, AI retrospectives, and internal knowledge forums can normalize AI use and build organizational confidence. By framing these activities as strategic learning investments, they align with Bugaboo’s iterative design culture and foster both competence and curiosity among teams.

#### *10.4.1.4. Culture: Foster a Safe Space for Experimentation and Bottom-Up Innovation*

While tools can be deployed quickly, cultural readiness takes longer to cultivate. Jöhnk et al. (2021) describe innovativeness, collaboration, and change management as core cultural components that shape AI readiness. Bugaboo’s strong, design-led culture provides a good starting point, but leadership must actively cultivate a space where experimentation is safe and encouraged. Psychological safety is essential: failing fast with AI prototypes must be seen as acceptable when lessons are fed back into the design loop. Moreover, AI adoption should leverage cross-functional collaboration, blending design, engineering, compliance, and research expertise, to break silos and create dynamic AI squads. Importantly, bottom-up innovation must be embraced. Instead of prescribing all AI applications top-down, Bugaboo should capture and scale grassroots experiments through showcases, feedback loops, and small funding mechanisms like microgrants, nurturing the organic emergence of valuable use cases.

#### *10.4.1.5. Data: No Need for a Data Lake, Just Get Your Files in Order*

For a company like Bugaboo, data readiness is less about building complex data infrastructures and more about getting core files and documentation in order. According to Jöhnk et al. (2021), AI readiness depends on data that is available, high-quality, accessible, and able to flow efficiently into tools and workflows.

Good file quality and structure are key. Design files, regulatory documents, user feedback, and test reports need to be clearly named and neatly organized. Generative AI tools can only work well if the input they get is clean and easy to understand. Using the same naming rules, language, and versioning everywhere also makes it much faster and easier to start working with AI tools and helps get better results.

Having one central place to store files is just as important. Teams working with AI should be able to find what they need quickly, without having to ask around or wait for access. It's not about building some massive, complicated database; it's simply about making sure folders are tidy, searchable, and easy to get into.

Finally, it needs to be clear which files are safe to use with AI. A simple system, like tagging files that are for internal use only or that contain sensitive information, will help teams pick the right content and avoid mistakes.

In sum, Bugaboo doesn't need a big data strategy; it needs a smart file strategy. Reliable, accessible, and clearly structured information is what will make generative AI useful and scalable across product development.

#### *10.4.1.6. Conclusion: Build for Fit, Not Just Function*

In summary, laying a strong foundation for generative AI adoption at Bugaboo means deliberately cultivating readiness across all five dimensions articulated by Jöhnk et al. (2021). However, the effort must go beyond mechanical implementation. It requires a purposeful articulation of AI's role in a company where design, quality, and creativity are already high-functioning. Without that "why," even the most sophisticated AI capabilities risk becoming solutions in search of a problem.

#### *10.4.2. From Experiments to Scale: A Roadmap for Generative AI at Bugaboo*

The following roadmap outlines a short-term and medium-term trajectory rooted in the dimensions described in the previous section and tailored to the specific context of Bugaboo's operations and strategic orientation.

##### *10.4.2.1. Short-Term (0–6 Months): Build Momentum and Remove Friction*

In the next six months, Bugaboo must shift its focus from only piloting isolated generative AI tools toward structured, real-world integration within product development workflows. This transition begins with formalizing the strategic intent behind AI adoption. Leadership should clearly define how generative AI supports the company's mission of delivering high-quality, design-led juvenile products and articulate success metrics such as reduced time-to-concept, accelerated iteration cycles, or improved synthesis of user insights.

Establishing a cross-functional AI committee, composed of representatives from design, engineering, compliance, and data teams, will ensure coordination, prioritize use cases, and embed AI into top-level planning efforts. This organizational anchoring reflects the "strategic alignment" dimension of AI readiness identified by Jöhnk et al. (2021).

Operationally, several immediate steps will focus on removing friction points identified in the early pilots. The formulation of a simple but explicit “*Allowed AI Uses*” document, developed collaboratively with IT leadership, has already proven to be a key accelerator for safe experimentation. This governance mechanism should now be socialized across teams to build shared understanding and confidence. Concurrently, select generative tools such as InsightGPT and CreAIte should be deployed in live development contexts, starting with targeted sprints tied to current product initiatives. These deployments will surface integration gaps and create opportunities for iterative refinement, while demonstrating tangible value.

To support this, Bugaboo must invest in both people and data. A short-form AI onboarding program should be launched, focused on raising literacy around prompt engineering, model behavior, and responsible use. Internal champions, those who’ve led or participated in pilot projects, can act as early mentors, helping peers engage with the tools effectively. On the data side, priority should be given to organizing core assets such as design files, test protocols, and research transcripts. This means cleaning, labeling, and centralizing datasets to ensure teams can find and use the information required for AI-enhanced workflows. Rather than pursuing large-scale infrastructure projects, the focus should remain on practical file management, ensuring content is versioned, interoperable, and stored accessibly.

Culturally, the emphasis should be on sustaining momentum without forcing transformation. Generative AI is still a nascent capability, and value will emerge unevenly. Teams must feel empowered to experiment, share learnings, and adapt. Leadership’s role is to foster psychological safety, promote visibility of small wins, and ensure that early efforts are integrated back into team practices rather than treated as one-off explorations. In this way, the short-term roadmap is less about deploying AI at scale and more about enabling the organization to build readiness, one meaningful, supported experiment at a time.

#### *10.4.2.2. Medium Term (6–18 Months): Embed AI Into Workflows and Decision-Making*

In the medium term, Bugaboo must move from piloting generative AI to embedding it into core product development workflows. The early use cases will have shown where generative AI adds value; now, the focus shifts to institutionalizing those gains and scaling them across teams and processes. The aim is not to introduce AI for its own sake, but to integrate it where it genuinely enhances creative range, speeds up iteration, or improves regulatory preparedness.

Strategically, AI should be embedded into project planning and decision-making. This involves formalizing its role in key activities like concept generation, user insight synthesis, and design variant development. Objectives, workflows, and team templates should reflect this shift. As Jöhnk et al. (2021) emphasize, strategic alignment and process fit are critical at this stage; AI must be tied directly to business priorities to remain viable at scale.



Operationally, best practices from the pilots should now be codified. Prompt strategies, output validation protocols, and usage tips can be formalized into internal playbooks. AI champions, already emerging informally, should be given defined roles across teams, acting as quality stewards and lightweight governance agents. Simultaneously, hybrid roles may need to evolve: designers may take on prompt ideation, while PMs build AI literacy into their core competencies.

On the data side, focus should shift from broad access to curated readiness. Bugaboo should develop structured, product-specific datasets that are well-tagged, versioned, and standardized so that teams can plug generative tools into their actual workflows. This isn't about building a complex platform but ensuring that core assets like specs, test protocols, and research notes are reliable, traceable, and accessible.

Culturally, this is the phase where engagement risks tapering off. Generative AI may begin to feel routine, or its usefulness may be questioned. To counteract this, leadership must link AI to tangible improvements, shorter cycles, better ideas, and smoother compliance. Internal reviews should surface both successes and failures, reinforcing iterative learning and spotlighting areas needing refinement.

Critically, teams must retain the posture identified during your internship: AI was introduced into a context that already worked. Its role now is to augment, not replace, trusted processes. This means asking hard questions: when does AI truly help? Where does it add noise or risk? By staying grounded, selective, and design-led, Bugaboo can scale generative AI in a way that is both purposeful and sustainable.

#### *10.4.2.3. Long-Term (24+ Months): Sustain a Learning Culture Around Generative AI*

In the long term, Bugaboo's success with generative AI will depend less on tools and infrastructure and more on sustaining a mindset of continuous learning, experimentation, and responsible integration. By this stage, the foundational elements, strategic alignment, workflows, data readiness, and cross-functional capabilities should be in place. What comes next is the cultural reinforcement of AI as a natural, embedded part of how Bugaboo imagines, develops, and delivers new products.

A generative AI culture does not mean turning every process over to automation. Rather, it involves developing a shared confidence in AI's role as a creative and operational partner. Employees must trust that AI is here to assist, not displace, their expertise, and that its use is aligned with Bugaboo's design values, quality standards, and ethical commitments. That trust is built over time, through consistent use, transparent decision-making, and the active curation of good (and bad) use cases.

To support this, Bugaboo should establish lightweight but lasting internal structures: an AI playbook that evolves as tools and practices mature, a set of ethical usage guidelines embedded into product checkpoints, and recurring forums, such as retrospectives or demo

days, where teams share what they've learned. These rituals ensure that knowledge does not fade and that AI practices remain adaptable, not rigid.

Leadership also plays a vital role in keeping AI visible without making it performative. Generative AI should be integrated into planning and performance reviews, not as a checkbox, but as a meaningful enabler of outcomes. Where teams have made progress, reducing iteration cycles, generating better testing scenarios, or exploring new design spaces, those results should be recognized, not only for what was achieved, but for how AI enabled it.

Importantly, Bugaboo must remain vigilant against complacency or overreach. As the AI landscape evolves, new risks will emerge around privacy, bias, overdependence, or user trust. A generative AI culture includes a readiness to pause, recalibrate, or even scale back when needed. It values discernment over adoption for its own sake.

By embedding AI into the rhythms of the company, not just the strategy documents, Bugaboo can foster a durable, design-led, and human-centered approach to AI adoption. One where the organization doesn't just use AI but evolves alongside it.

#### *10.4.2.4. Summary: Make AI a Habit, Not a Hype*

Sustaining a generative AI culture at Bugaboo means going beyond successful pilots or scaled deployments. It requires embedding AI into the company's habits, language, and ways of working, while reinforcing a culture that is experimental but cautious, innovative but grounded. This long-term integration depends on evolving internal playbooks, supporting shared learning structures, and maintaining a clear sense of when and why AI adds value. Only then can AI continue to support, not disrupt, the creativity, care, and craftsmanship that define Bugaboo's approach to product development.

### *10.5. Thesis Conclusion: Generative AI Reshapes the Rhythm of Design, Not Its Roots*

This thesis explored the role of generative AI within the design practice at Bugaboo, an organization rooted in creativity, craftsmanship, and user-centered thinking. It examined how AI can augment, rather than disrupt, an already effective human-centered design process. The core finding is clear: generative AI reshapes the rhythm of design without redefining its principles.

Through the integration of three bespoke tools, InsightGPT, CreAIte, and RulesGPT, aligned with the Frame–Propose–Evaluate (FPE) simplified model of design developed in this thesis, generative AI demonstrated its ability to accelerate framing, expand proposing, and surface constraints faster during evaluation. These interventions were mapped onto the core uncertainty reduction actions that structure early-stage product development: information action (organizing and synthesizing user and market insights), representation

action (visualizing and broadening concept exploration), and reflective action (interpreting feasibility and compliance constraints) (Cash and Kreye, 2017).

Overall, the findings showed that generative AI integration did not alter the structure of design activities but intensified and redistributed effort within them. Throughout the sessions, designers spent less time on manual synthesis, sketching, and regulatory research, and more time on interpretation, prompt refinement, and convergence. AI tools enabled faster iteration cycles and more fluid overlaps between framing, proposing, and evaluating, encouraging a quicker rhythm of partial clarification, exploration, and reflection.

Across all interventions, generative AI proved most effective when treated as a provocation engine, supporting breadth of exploration without replacing human authorship. InsightGPT stimulated questioning of assumptions and rapid testing of emerging hypotheses, CreAIté Flow opened new aesthetic directions and accelerated visual ideation, and RulesGPT exposed regulatory considerations faster in concept development. In all cases, the AI tools enhanced divergence but did not substitute for depth of judgment, confirming that their greatest value lay in stimulating exploration during the early stages of design.

Prompting emerged as a critical design literacy throughout the pilots. The quality of input prompts heavily determines the relevance and usefulness of AI outputs. Designers learned to construct prompts that were neither too vague nor too restrictive, balancing creative openness with directional specificity. Prompt formulation thus became a form of meta-design, where the designer shaped the conditions of AI output and steered exploration.

Another consistent pattern was the ease of divergence and the difficulty of convergence. AI tools such as CreAIté Flow could produce an overwhelming number of plausible design variants, leading to decision fatigue if not carefully managed. Generating options became effortless, but selecting the right direction remained firmly in the hands of human designers. Convergence processes such as editorial filtering and clear stopping criteria proved essential to translate AI's generative abundance into actionable outcomes.

Despite their strengths, the AI tools consistently demonstrated limitations in contextual reasoning. InsightGPT's synthesized personas lacked the emotional richness of live interviews, CreAIté's visuals failed to capture real-world ergonomic constraints, and RulesGPT's interpretations of regulations required expert review. These limitations reaffirmed that while AI can efficiently synthesize patterns and offer first drafts, only human designers can embed outputs within real-world constraints, user empathy, and embodied experience. AI augmented design breadth, but design depth remained reliant on human insight and validation.

Trust in AI tools grew when transparency and human oversight were maintained. Designers did not expect perfection from the AI but wanted clarity about how outputs were generated and where knowledge originated. Trust increased when AI systems openly cited their sources, admitted uncertainty, and when outputs were cross-checked against empirical

data. Maintaining human-in-the-loop workflows ensured that AI contributions were integrated thoughtfully, reinforcing rather than undermining ownership of outcomes.

These findings led to the formulation of a set of actionable principles for responsible AI integration. Generative AI delivers the greatest value when used early in the design process, where ambiguity is highest and exploration is most needed. Clear and specific prompting is essential to obtain relevant and meaningful outputs, requiring designers to develop a new literacy in framing queries. AI should be positioned as a source of options, not conclusions, with human designers retaining the role of critical evaluators. Divergence, while easy, must be counterbalanced by deliberate convergence practices to prevent decision paralysis. Human-centered context remains irreplaceable, demanding that AI outputs be interpreted through the lens of embodied, experiential knowledge. Trust in AI tools is built through transparency, traceability, and continuous human oversight, reinforcing team agency rather than replacing it.

At the organizational level, the research highlights that sustainable adoption of generative AI requires more than technical capability. It demands cultural openness to experimentation, strategic alignment with design goals, governance frameworks that ensure ethical use, and a strong sense of purpose guiding AI's role within the organization. Without these foundations, even the most sophisticated tools risk becoming detached from real needs and real users.

Ultimately, this thesis advocates for a posture of critical augmentation: embracing generative AI as an early-stage partner that sharpens inquiry, accelerates iteration, and expands creative horizons, while preserving human responsibility for meaning-making, validation, and judgment. Generative AI can reshape the rhythm of design, but not its roots. When embedded thoughtfully, it can amplify human ingenuity without displacing the human values, empathy, creativity, and responsibility that remain at the heart of new product development at Bugaboo.

#### *10.5.1. Limitations: Contextual Boundaries and Unanswered Questions*

While this thesis offers grounded insights into the integration of generative AI within Bugaboo's design practice, several limitations frame the scope of its conclusions. The tools, InsightGPT, CreAIte, and RulesGPT, were designed and tested specifically within the juvenile product domain, a space characterized by strict regulatory demands and strong requirements for brand continuity. These contextual factors influenced both the tool designs and the criteria for judging their effectiveness, limiting the direct applicability of findings to other industries.

The research was conducted within the timeframe of an internship, during which the tools remained in prototype form and were primarily used in exploratory, early-stage design settings. Consequently, long-term adoption, sustained impact, and integration into everyday workflows remain untested.

Another limitation concerns the role of prompt engineering. Teams developed prompting skills informally, without structured training programs, shared frameworks, or institutional support mechanisms, resulting in variability in the quality and effectiveness of tool use.

Additionally, representational constraints of the AI systems became evident. Generative outputs often mirrored common patterns from the underlying training data, which at times reinforced normative biases or led to the production of homogenous ideas unless carefully directed by users.

Finally, as an exploratory study, the thesis employed qualitative methods and focused on early and mid-stage design activities. It did not quantify impacts on productivity or decision quality, nor did it track AI-supported concepts through subsequent stages such as prototyping, market validation, or post-launch performance.

#### *10.5.2. Future Research: What Needs to Be Explored Next*

Future work should address these gaps through longer-term and broader investigations. Longitudinal studies are needed to understand whether AI tools remain useful as they move from pilot to routine use and how their perceived value evolves over time.

Comparative research across industries could help distinguish which integration patterns are context-dependent and which are more generalizable. Further research should also focus on the formalization of prompt literacy and the development of training programs, libraries, and tools that support high-quality, context-sensitive prompting across roles. In parallel, new strategies are needed to detect and mitigate bias in generative outputs, ensuring they support diversity and innovation rather than reinforcing defaults.

Mixed-method approaches could provide a more complete picture of AI's value, combining observational insights with metrics such as design cycle duration, idea variation, or usability outcomes. Additionally, studies should trace the downstream performance of AI-influenced decisions, especially in regulated or safety-critical contexts. Finally, as AI becomes more embedded in decision-making, governance, traceability, and accountability mechanisms must evolve. Future research should explore how organizations document AI-influenced outcomes, distribute responsibility between humans and systems, and define ethical boundaries for design use. Together, these directions can guide more robust, equitable, and effective integration of generative AI in design practice.

## Epilogue: In the In-Between, AI Finds Its Place

Design happens in the in-between, between sketch and decision, between question and idea. It does not follow a straight path. Instead, it unfolds through exploration, reflection, and uncertainty. This thesis followed that path, not to ask whether AI can design, but to understand how it might walk alongside the process of design, without disrupting what makes it human.

What became clear is that generative AI is not a replacement for creativity, but a partner to it. In a field where ambiguity is constant and iteration is essential, generative AI finds its role not in taking over, but in expanding what's possible. It opens up new directions. It speeds up exploration. It makes space for designers to focus on meaning.

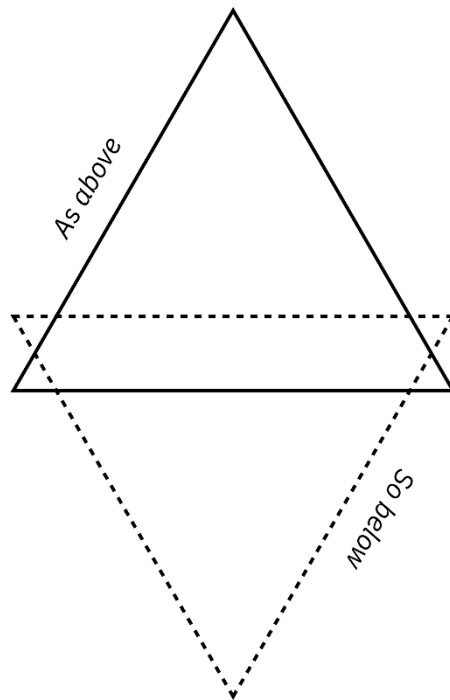
The three tools developed, InsightGPT, CreAIté, and RulesGPT, were designed not to automate decisions but to support them. Each entered at a different moment in the Frame–Propose–Evaluate rhythm, and each made the invisible parts of design more visible. Their real value came not from perfect answers, but from how they invited better questions. They helped designers see more, think differently, and stay close to what matters.

An important part of this journey was that even as a designer without deep technical expertise, I was able to build working AI prototypes. This accessibility speaks to one of the most empowering findings of the project: that generative AI, when approached critically and pragmatically, can be shaped by designers themselves. It does not require ceding control to engineers or technologists. Instead, it opens the door for creative practitioners to actively mold how AI enters their practice, on their terms, and in service of their craft.

This research does not end with clear conclusions. Instead, it highlights the ongoing role of uncertainty in design. AI does not remove that uncertainty, but it can help navigate it more easily. It can bring new options into view, challenge assumptions, or reveal things that were hard to see; becoming a tool for reflection, not just speed.

Design will remain a human act, messy, contextual, and emotional. But AI can play a role in shaping how that act unfolds. Not by leading, but by accompanying. Not as a master, but as a thoughtful assistant. The goal is not to hand over the process, but to enrich it.

This thesis is not a final answer. It is an orientation. Toward tools that respect the creative process. Toward methods that stay reflective. And toward futures where designers remain central, not despite AI, but alongside it.



## References

- Amankwah-Amoah, J., Abdalla, S., Mogaji, E., Elbanna, A., & Dwivedi, Y. K. (2024). The impending disruption of creative industries by generative AI: Opportunities, challenges, and research agenda. *International Journal of Information Management*, 79, 102759.
- Bang, Y., Cahyawijaya, S., Lee, N., Dai, W., Su, D., Wilie, B., ... & Fung, P. (2023). A multitask, multilingual, multimodal evaluation of chatgpt on reasoning, hallucination, and interactivity. *arXiv preprint arXiv:2302.04023*.
- Berni, A., Borgianni, Y., Rotini, F., Gonçalves, M., & Thoring, K. (2024). Stimulating design ideation with artificial intelligence: present and (short-term) future. *Proceedings of the Design Society*, 4, 1939-1948.
- Bilgram, V., & Laarmann, F. (2023). Accelerating innovation with generative AI: AI-augmented digital prototyping and innovation methods. *IEEE Engineering Management Review*, 51(2), 18-25.
- Bouschery, S. G., Blazevic, V., & Piller, F. T. (2023). Augmenting human innovation teams with artificial intelligence: Exploring transformer-based language models. *Journal of product innovation management*, 40(2), 139-153.
- Cash, P., & Kreye, M. (2017). Uncertainty-driven Action (UDA) model: A foundation for unifying perspectives on design activity. *Design Science*, 3, e26.
- Chiang, C. W., Lu, Z., Li, Z., & Yin, M. (2024, March). Enhancing AI-Assisted Group Decision Making through LLM-Powered Devil's Advocate. In *Proceedings of the 29th International Conference on Intelligent User Interfaces* (pp. 103–119).
- Chiou, L. Y., Hung, P. K., Liang, R. H., & Wang, C. T. (2023, July). Designing with AI: An exploration of co-ideation with image generators. In *Proceedings of the 2023 ACM designing interactive systems conference* (pp. 1941–1954).
- Cockburn, I. M., Henderson, R., & Stern, S. (2018). The impact of artificial intelligence on innovation (Vol. 24449). Cambridge, MA, USA: National bureau of economic research.
- Davis, F. D. (1989). Technology acceptance model: TAM. Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption, 205(219), 5.
- Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution. *Design studies*, 22(5), 425-437.
- Duan, P., Warner, J., Li, Y., & Hartmann, B. (2024, May). Generating automatic feedback on ui mockups with large language models. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (pp. 1–20).
- Fan, J., Kalyanpur, A., Gondek, D. C., & Ferrucci, D. A. (2012). Automatic knowledge extraction from documents. *IBM Journal of Research and Development*, 56(3.4), 5-1.
- Fan, W., Wallace, L., Rich, S., & Zhang, Z. (2006). Tapping the power of text mining. *Communications of the ACM*, 49(9), 76–82.



- Fui-Hoon Nah, F., Zheng, R., Cai, J., Siau, K., & Chen, L. (2023). Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration. *Journal of information technology case and application research*, 25(3), 277–304.
- Füller, J., Hutter, K., Wahl, J., Bilgram, V., & Tekic, Z. (2022). How AI revolutionizes innovation management—Perceptions and implementation preferences of AI-based innovators. *Technological Forecasting and Social Change*, 178, 121598.
- Gama, F., & Magistretti, S. (2025). Artificial intelligence in innovation management: A review of innovation capabilities and a taxonomy of AI applications. *Journal of Product Innovation Management*, 42(1), 76–111.
- Grandi, D., Jain, Y. P., Groom, A., Cramer, B., & McComb, C. (2025). Evaluating large language models for material selection. *Journal of Computing and Information Science in Engineering*, 25(2), 021004.
- Gu, H., Chandrasegaran, R. S. K., & Lloyd, P. (2025). Synthetic users.
- Hatchuel, A. (2001). Towards design theory and expandable rationality: the unfinished program of Herbert Simon. *Journal of management and governance*, 5(3/4), 260–273.
- Hatchuel, A., & Weil, B. (2003). A new approach of innovative Design: an introduction to CK theory. In *DS 31: Proceedings of ICED 03, the 14th International Conference on Engineering Design*, Stockholm.
- Holmström, J., & Carroll, N. (2024). How organizations can innovate with generative AI. *Business Horizons*.
- Hwang, A. H. C. (2022, April). Too late to be creative? AI-empowered tools in creative processes. In *CHI conference on human factors in computing systems extended abstracts* (pp. 1–9).
- Jakesch, M., Hancock, J. T., & Naaman, M. (2023). Human heuristics for AI-generated language are flawed. *Proceedings of the National Academy of Sciences*, 120(11), e2208839120.
- Jöhnk, J., Weißert, M., & Wyrski, K. (2021). Ready or not, AI comes—an interview study of organizational AI readiness factors. *Business & information systems engineering*, 63(1), 5–20.
- Kakatkar, C., Bilgram, V., & Füller, J. (2020). Innovation analytics: Leveraging artificial intelligence in the innovation process. *Business Horizons*, 63(2), 171–181.
- Kim, S. J. (2024). Generative artificial intelligence in collaborative ideation: Educational insight from fashion students. *IEEE Access*.
- Klein, G. (2011). Expert intuition and naturalistic decision making. In *Handbook of intuition research*. Edward Elgar Publishing.
- Kucharavy, A., Plancherel, O., Mulder, V., Mermoud, A., & Lenders, V. (2024). Large Language Models in Cybersecurity: Threats, Exposure and Mitigation (p. 247). Springer Nature.
- Liu, Y., Wei, W., Liu, J., Mao, X., Fang, R., & Chen, D. (2022, October). Improving personality consistency in conversation by persona extending. In *Proceedings of the 31st ACM International Conference on Information & Knowledge Management* (pp. 1350–1359).
- Mariani, M., & Dwivedi, Y. K. (2024). Generative artificial intelligence in innovation management: A preview of future research developments. *Journal of Business Research*, 175, 114542.

Marion, T. J., & Fixson, S. (2018). *The innovation navigator: Transforming your organization in the era of digital design and collaborative culture*. University of Toronto Press.

Park, J. S., O'Brien, J., Cai, C. J., Morris, M. R., Liang, P., & Bernstein, M. S. (2023, October). Generative agents: Interactive simulacra of human behavior. In *Proceedings of the 36th annual acm symposium on user interface software and technology* (pp. 1-22).

Rawte, V., Sheth, A., & Das, A. (2023). A survey of hallucination in large foundation models. *arXiv preprint arXiv:2309.05922*.

Redifer, J. L., Bae, C. L., & DeBusk-Lane, M. (2019). Implicit theories, working memory, and cognitive load: Impacts on creative thinking. *Sage Open*, 9(1), 2158244019835919.

Requejo, W. S., Martínez, F. F., Vega, C. A., Martínez, R. Z., Cendrero, A. M., & Lantada, A. D. (2024). Fostering creativity in engineering design through constructive dialogues with generative artificial intelligence. *Cell Reports Physical Science*, 5(9).

Roozenburg, N. F. M., & Eekels, J. (1995). *Product design: Fundamentals and Methods*.

Salter, A., Ter Wal, A. L., Criscuolo, P., & Alexy, O. (2015). Open for ideation: Individual-level openness and idea generation in R&D. *Journal of Product Innovation Management*, 32(4), 488–504.

Schön, D. A. (1979). *The reflective practitioner*. New York.

Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action design research. *MIS quarterly*, 37–56.

Serra, G. (2024). Integration Of AI Tools In The Product Design Workflow Integration Of AI Tools In The Product Design Workflow (Master's thesis, University of Twente).

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological review*, 63(2), 129.

Simon, H. A. (1972). Theories of bounded rationality. *Decision and organization*, 1(1), 161–176.

Sofka, W., & Grimpe, C. (2010). Specialized search and innovation performance—evidence across Europe. *R&D Management*, 40(3), 310–323.

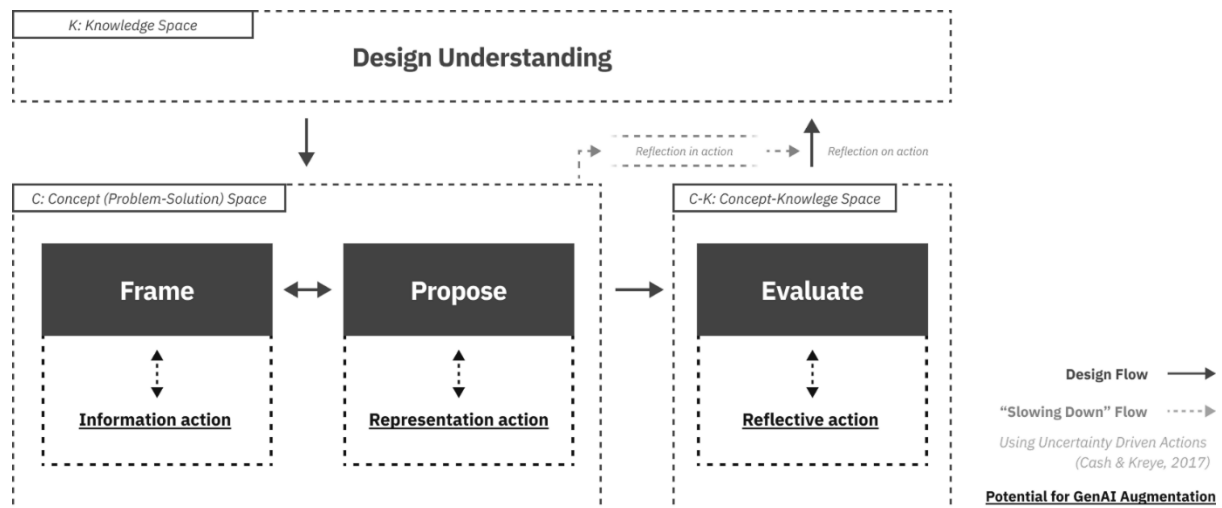
Wadinambiarachchi, S., Kelly, R. M., Pareek, S., Zhou, Q., & Velloso, E. (2024, May). The effects of generative ai on design fixation and divergent thinking. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (pp. 1–18).

Yin, H., Zhang, Z., & Liu, Y. (2023). The exploration of integrating the midjourney artificial intelligence generated content tool into design systems to direct designers towards future-oriented innovation. *Systems*, 11(12), 566.

## Appendices

## Appendix A - Describing the Frame, Propose, Evaluate Model

The *Frame–Propose–Evaluate* (FPE) simplified model of design (Figure 32) offers a concise lens for understanding how design unfolds in day-to-day practice. FPE highlights an iterative pathway that designers follow when confronting the messy realities of uncertainty.



**Figure 32.** The *Frame–Propose–Evaluate* simplified model of design which I developed during the thesis

FPE is not a prescriptive model or process blueprint. Rather, it is a lens, a way to identify the shape and rhythm of design work as it occurs. It allows observers, participants, and tool developers (like me) to ask targeted questions: *Where is the team right now in its thinking? What kind of support would enhance progress without disrupting the creative flow? What uncertainty is driving the current action?*

This appendix elaborates upon the core components of FPE and describes how they interrelate. It draws on real patterns observed during my fieldwork at Bugaboo and connects them back to the theoretical concepts discussed in earlier sections. Importantly, each component of FPE also maps to distinct opportunities for AI augmentation: not as a substitute for design activity, but as a complementary agent that can enhance information synthesis, expand representation, or scaffold reflection at the right time.

### A.1. Understanding: Building on What’s Already Known (K-Space)

At the top of the FPE framework is Understanding, situated in what Hatchuel and Weil (2003) would describe as the Knowledge Space (K-space). This space encompasses accumulated insights, prior project learnings, technical constraints, user research, regulatory standards, and internal guidelines. It forms the initial foundation from which design activity departs.

However, the K-space is not static. It evolves as new information is discovered or as context shifts. For instance, a Bugaboo team may rely on existing user research to define stroller ergonomics, only to realize mid-project that the insights are no longer valid for a new

market or age group. At such moments, the boundaries of what is "known" are changed, and the concept must be re-evaluated, creating the need to move into the more exploratory Concept Space. It sets the stage for the first core move of design: Framing.

### A.2. Frame: Defining the Right Problem

Within the Concept Space, the first critical move is Frame: the stage where designers define the problem, identify key user segments or performance criteria, and clarify benchmarks for success. At Bugaboo, this might involve asking, *"Is foldability our primary concern, or is advanced suspension for off-road terrain more critical?"* or *"Should we optimize for user convenience or cost efficiency?"* These framing questions establish the parameters that guide subsequent design decisions.

Drawing on Klein's (1998) Recognition-Primed Decision (RPD) model, experienced designers often identify similarities between the current challenge and past cases, allowing them to adapt known solutions efficiently. However, when faced with a truly novel situation, they intentionally slow down and engage in information action, aligning with the Uncertainty-Driven Action (UDA) model's emphasis on identifying and resolving knowledge gaps. This might involve reviewing new user research, benchmarking against competitor products, or consulting experts (e.g., safety engineers) to assess feasibility.

If contradictions arise, such as a prototype failing strength tests, the design frame must be reconsidered. This is why the Frame–Propose–Evaluate (FPE) model represents a two-way relationship between Frame and Propose, reflecting the co-evolution of problem and solution, as described by Dorst and Cross (2001). In practice, this might mean shifting a goal from *"the lightest stroller on the market"* to *"a highly durable stroller with moderate weight"*, an adjustment prompted by, for instance, testing that reveals how extreme weight reduction compromises structural integrity.

### A.3. Propose: Generating and Externalizing Ideas

Once a satisficing frame is set, the designer shifts into Propose, the second major move. Here, creativity takes center stage as designers ideate possible solutions, each shaped by the frame decided upon in the Frame phase. Crucially, *Propose* is supported by representation action. Instead of keeping ideas purely abstract or verbal, designers at Bugaboo often externalize them through sketches, digital models, or physical prototypes, fueling reflection-in-action. These representations serve multiple purposes:

1. **Revealing the Unexpected:** Physical or visual representations often reveal hidden flaws or potentials that remained invisible during purely conceptual debates. A quick 3D-printed seat button at Bugaboo might show that a particular latch is awkward to operate for caregivers with limited hand strength.
2. **Facilitating Team Alignment:** Externalized proposals act as shared reference points for the next evaluation phase, enabling cross-functional dialogue. An engineering

lead might see an unforeseen mechanical conflict, while a user researcher notices a potential mismatch between brand promises and the design's aesthetic.

3. **Enabling Iteration and Variation:** At Bugaboo, it is common to produce multiple prototypes, tweaking dimensions, materials, or colorways, to gauge which versions best meet the framed criteria. These proposals feed data back into framing if, for instance, the prototypes prove too costly or fail user testing.

So, as soon as prototypes take form, interesting tensions emerge. Designers might realize the solution conflicts with an earlier assumption or that it partially resolves one user need while neglecting another. In practice, these tensions trigger more “reframing” or new proposals, hence the double arrow, shown in the FPE diagram, representing frequent back-and-forth between Frame and Propose.

#### *A.4. Evaluate: Testing, Feedback, and Reflecting*

Every significant proposal ultimately advances to Evaluate, the third central move in the FPE framework. Here, the designer tests solutions against constraints, user feedback, and technical or manufacturing realities. Evaluations can take many forms, internal design discussions, mechanical stress tests, user trials in real-life contexts, or strategic dialogues about market positioning.

At Bugaboo, a new stroller design might undergo internal evaluations or be tested by parents in everyday routines, revealing unexpected friction points. These observations fuel reflective action, the (collaborative) sense-making process that supports the entire Evaluate phase. Industrial designers, engineers, product managers, and marketing teams all converge to interpret the findings, ensuring that multiple perspectives shape the outcome. For instance, the regulations expert might uncover a regulatory issue that prompts a return to either re-frame priorities or propose alternatives.

The insights gathered in this phase loop upward to Understanding (K), reflecting Schön's (1979) concept of “reflection-on-action.” By documenting and synthesizing results into the broader Knowledge Space, the team establishes new baselines for future projects. For example, discovering that materials wear out rapidly in sunny climates might lead Bugaboo's material specialists to adjust their general product guidelines, informing subsequent design efforts with more robust material specifications.

#### *A.5. Supportive Actions How Designers Respond to Uncertainty*

The diagram (Figure 32) includes dotted regions labeled Information Action, Representation Action, and Reflective Action, all recognized as supportive responses to uncertainty or insufficient clarity (Cash and Kreye, 2017):

- **Information Action** occurs when the design team realizes it does not have enough data to shape or maintain a frame confidently. They might pause to gather additional user insights or finalize cost estimates.

- **Representation Action** takes place when abstract discussions fail to resolve a question, and the team needs a prototype or visual to proceed.
- **(Co-)Reflective Action** arises when sensemaking is needed or multiple viewpoints, users, engineers, designers, managers, need to converge to interpret results, ensuring that different forms of expertise shape the design.

At Bugaboo, these supportive actions frequently appear spontaneously. A single conversation about handle shape might spark a rapid 3D printed model (representation action), enabling immediate feedback (reflective action), leading back to investigating new materials (information action) if the concept requires a premium feel.

#### *A.6. Concluding the Loop: Design as a Continuous Cycle*

Seen holistically, Frame–Propose–Evaluate offers a vibrant picture of how designers steer through the intangible and sometimes chaotic nature of product design. Starting from the Knowledge Space, they steadily refine problems, propose solutions, and evaluate those solutions in real contexts. Throughout, supportive actions triggered by uncertainty, gathering extra data, prototyping novel ideas, or bringing sensemaking and more perspectives into the conversation, maintain momentum and depth of inquiry.

## Appendix B. Workshop Analysis and Outcomes

To uncover practical opportunities for integrating generative AI into early-stage design at Bugaboo, I conducted a structured workshop with a diverse group of designers. The workshop aimed to surface current challenges, understand designers' values, and generate forward-looking ideas for AI support grounded in real work experiences.

### B.1. Workshop Structure and Activities

I organized the workshop into six sequential activities that guided participants from personal reflection to collaborative concept development. Each activity built on the last, starting with individual insights and ending with concrete AI tool proposals. Table 7 outlines the purpose and duration of each phase.

We began with a grounding activity to connect ideas to participants' personal motivations. From there, participants mapped their experiences across typical projects, highlighting emotional highs and lows. This mapping informed the next phase, blue sky ideation, where participants imagined ideal AI tools without technical constraints. After a short break, I introduced real-world AI examples to help them translate their visionary ideas into practical concepts. We wrapped up by discussing key insights and outlining next steps for further exploration.

**Table 7.** Workshop Activities and Their Purpose

Activity	Duration	Purpose
<b>Context and Introduction</b>	5 minutes	I introduced the workshop's objectives, emphasizing the exploration of AI's potential to enhance the design experience.
<b>Personal Insight: Who Are You?</b>	10 minutes	Participants reflected on their motivations and what they enjoy about being designers. This helped ground their perspectives, ensuring their ideation would be relevant to their values and work practices.
<b>Typical Project: Practices and Experiential Curve</b>	15 minutes	Designers mapped out their experiential journey during a typical or recent project, identifying pain points and successes. This provided insights into areas where AI solutions could be beneficial.
<b>Blue Sky Thinking: AI Magic Wand</b>	20 minutes	Participants engaged in creative thinking to envision ideal AI tools. This activity allowed them to think freely and imagine blue sky AI solutions that could address their challenges without technical limitations.
<b>Break</b>	10 minutes	—
<b>AI Examples and Solution Formulation</b>	20 minutes	The facilitator presented real-world AI tools relevant to design, guiding participants to turn their blue sky ideas into actionable and realistic AI concepts that could be integrated into their design processes.
<b>Wrap-Up and Next Steps</b>	10 minutes	The session concluded with a discussion summarizing key insights and outlining next steps for further exploring and implementing AI solutions in their work.



## B.2. What Designers Value in Their Work

Designers consistently expressed passion for the autonomy, creativity, and user impact their roles offer. Table 8 captures quotes and insights that reveal what energizes them, starting fresh with a blank page, transforming ideas into prototypes, and working closely with colleagues and users. They described moments of excitement during early ideation and model-making, and emphasized the satisfaction of making life easier for parents through thoughtful design.

These reflections point to clear design principles for AI tools: they must support, not undermine, the autonomy and creativity designers cherish. Designers want tools that amplify their strengths and respect their processes, not systems that feel intrusive or overly prescriptive.

**Table 8.** *Design Practices and What Designers Enjoy from Workshop Transcript*

Category	Quote	Insight
<b>Freedom and Autonomy</b>	"There's not a lot of micromanaging around us... I feel that I'm responsible for what I do."	Emphasizes autonomy and the ability to make independent decisions.
<b>Impact on Users and Society</b>	"Working on products that people really like."	Satisfaction from creating products that resonate with users.
	"I like improving things, make it better and ask how we can do differently and make life of parents easier."	Desire to enhance user experiences and contribute positively to people's lives.
	"I understand how important it is to have a good product... and I love working with people."	Emphasizes both product quality and human connection.
<b>Creative Peaks</b>	"When there's a design idea... testing is when the design idea comes to life."	Highlights the excitement of transforming ideas into tangible prototypes.
<b>Initial Excitement</b>	"The start with a blank sheet is a kind of... it's nice, but also it feels insecure."	Reflects the mix of excitement and uncertainty at the project's outset.
	"Thinking about value proposition... that's really what I like."	Emphasizes the thrill of limitless possibilities during ideation phase.
	"I really enjoy always... everything is open, everything is possible."	Highlights the excitement of conceptualization.
	"I have two highs. The first high is the part where it's all blank where we can start and the sky's the limit... and then making models, which is my specialty."	Enthusiasm for both conceptualization and hands-on creation.
<b>Collaboration and Team Dynamics</b>	"It's all about creating and creating beauty and creating value, but that moment where the sum of all solutions is more than the separate solutions itself."	Celebrates the synergy achieved through teamwork.

"I like working with people... being a designer, you are behind the computer, but you are also downstairs with the stitching room. You are outside to research."	Appreciation for the multifaceted nature of design work and the interactions it entails.
"Creating a concept out of this... where the one-plus-one makes three."	Highlights the satisfaction from collaborative concept development.
"I love being with people, trying to understand them, and working with a big team."	Enjoyment from working with teams and building human connections.

### B.3. Pain Points and Design Frictions

Despite their enthusiasm, designers also pointed to frustrations and bottlenecks in their work. Table 9 shows the challenges they face, from rigid compliance requirements and tool limitations to cognitive blocks in the ideation process. Participants voiced annoyance with regulatory work that feels disconnected from safety, and some felt stuck when trying to visualize ideas or escape early design fixation.

These pain points present clear opportunities for AI intervention. Designers welcomed the idea of tools that could ease mental load, visualize concepts faster, or simulate design testing early in the process. They want help with the aspects of their work that feel repetitive, confusing, or creatively stifling.

**Table 9.** Design Frustrations and Challenges from Workshop Transcript

Category	Quote	Insight
<b>Regulatory and Quality Assurance Hurdles</b>	"What I'm really learning now is the regulation and quality... that's a very, very low for me because I'm learning that it's mostly politics and not much truly about safety in the end."	Expresses disillusionment with regulatory processes perceived as bureaucratic rather than beneficial.
<b>Creative Limitations and Fixation</b>	"I just get annoyed when I cannot make the stuff that I was imagining."	Frustration with creative constraints hindering creative expression.
	"The 3D part... I hate it. I always hate it."	Frustration towards not being able to visualize ideas in 3D.
	"AI can save the concept from my own ideation, because I often immediately get a solution and then I get married to it."	Acknowledges the challenge of becoming fixated on initial ideas, potentially limiting exploration, which AI could help with.
	"I have something in my head and what takes me longer is trying to find that representation online."	Frustration about not being able to find or visualize the ideas.

#### B.4. Opportunities Identified for AI Integration

When we explored potential AI applications, designers proposed a wide range of possibilities. Table 10 shows these ideas and the insights behind them. Participants imagined tools that automate compliance checks, track project status, and collect user feedback across digital channels. Others envisioned AI helping them break out of habitual thinking, compare design options, or simulate user interactions.

These ideas show that designers see AI not just as an efficiency tool, but as a creative partner. They want AI to provide alternative perspectives, highlight the unexpected, and extend their reach into areas they can't easily explore alone.

**Table 10.** AI Opportunities from Workshop Transcript

Idea	Quote	Insight
<b>Automating Compliance and Regulatory Tasks</b>	"Checking on compliance is always difficult... having some kind of chatbot that you can ask questions."	Envisions AI simplifying compliance checks.
<b>Enhancing Creativity and Ideation</b>	"If I have something like that, I can also look from other options quickly that will be quite helping me... AI can save the concept from my own ideation."	Suggests AI tools that provide alternative design options to overcome fixation.
<b>Streamlining Administrative Duties</b>	"It would be amazing if I could just talk to the computer and say, 'This project is delayed for three months... do it right now.'"	Desires AI assistance in project management tasks.
<b>Improving User Insights and Data Analysis</b>	"It would be nice if we could have information about how our users feel with our products that are already in the market... collecting from different digital channels."	Envisions AI aggregating and analyzing user feedback.
<b>Facilitating Non-Conventional Thinking</b>	"I would like to have the less conventional... AI can provide the obvious solutions... I would like to have... the things that are completely the opposite."	Desires AI tools that stimulate out-of-the-box ideas.
<b>Design Juggler</b>	"Play with the [design] priorities ... output is a composition of solutions that take all these considerations into account."	A conceptual AI that balances multiple design variables to generate cohesive solutions.
<b>Synthetic User / Person</b>	"I would like to have a user bot... like a person I can specify... and then I just ask them questions."	AI tool simulating user feedback for better understanding of target users.

During the final workshop session, participants translated their ideas into detailed AI tool concepts. Table 11 presents these proposals, which range from highly practical to deeply imaginative. Designers described tools that could fold geometry in CAD, simulate test scenarios in VR, generate ergonomic dimensions, or turn 2D sketches into refined 3D forms. They also wanted AI to help them build mood boards, visualize hard-to-define ideas, and summarize meetings or competitive research.

Many of these concepts directly influenced the design of InsightGPT, CreAIte, and RulesGPT, the AI prototypes tested later in this research. By involving designers early and grounding tool development in their lived experiences, we ensured that the resulting AI systems addressed real needs while remaining aligned with Bugaboo's design ethos.

**Table 11.** *AI Ideas from Workshop Sheets*

<b>Idea</b>	<b>Description</b>
<b>Side geometry puzzle - fold, all configurations in CAD, lots of trying out and reflecting.</b>	I give begin and end state, or certain size requirements, and AI gives the solution(s).
<b>Check on compliance.</b>	Have the product in VR or reality and simulate all the tests: analyzing, shearing, pinching points, stability, etc.
<b>FMEA helper.</b>	Think of all possible situations that can go wrong. Fill in all scoring and propose solutions.
<b>A planner I could talk to.</b>	I am making roadmap scenarios and have to fill in details for months. Would be nice to give verbal instructions instead of manually entering data.
<b>Autohour registrations.</b>	Based on calendar or tracking activities, fill in the hour registrations automatically.
<b>Having interactions/talks with users.</b>	Generate a user in VR that you can talk to, ask questions, and interact with personas representing users.
<b>Finish my technical design drawing puzzles.</b>	Work out my design drawings in detail so I can focus on more creative aspects.
<b>Drop some impossible solutions/ideas.</b>	Give me visually interesting new ideas (even if not feasible in real life) to help get me out of creative blocks.
<b>Do all the measurements for me.</b>	Ensure that the baby always fits properly in the product.
<b>Translate a SolidWorks shape into a pattern.</b>	Go from 3D drawings to 2D drawings in the fabrics domain.
<b>Give me some new ideas in the ideation phase.</b>	Create visuals with vague input I gave to make me rethink concepts and spark creativity.
<b>Bring me data when I need and want it.</b>	Provide data when requested based on specific needs.
<b>AI should make the product compliant (DEAN-BOT).</b>	If I make a prototype or mockup, the AI scans it and resolves all regulatory issues, if not solved physically, it suggests wording or loopholes.
<b>Help me make beautiful moodboards.</b>	Scan through busy images and help me create simple, eye-catching, and refined moodboards.
<b>Bugaboo DNA persona (Max).</b>	Ask AI if my work is true to Bugaboo's design and help solve styling, usage, or characteristic issues.
<b>AI as my average user (per country).</b>	A chatbot replaces user panels for constant interaction with the average user persona of different countries.
<b>Help me resolve product or styling issues in unconventional ways.</b>	AI feedback with images, text, and video showing me how to execute tasks in non-conventional ways.

<b>Make all the boring things for me (FMEA charts, administration, POR).</b>	Handle mundane tasks like FMEA charts, expense reports, timesheets, and trainings.
<b>User interaction</b>	Find all data of our users, parents, make personas and learn from/about them.
<b>House style accelerator</b>	Convert your draft presentations into Bugaboo house style.
<b>Make sketch beautiful</b>	Short sketching rough > beautify + variations.
<b>User research</b>	Answer all my questions like a chatbot regarding user experience in specific fields.
<b>Image generation to 3D</b>	Quickly translate something from 2D to 3D.
<b>Find pleasing options for a form/shape/color/texture of a HW or softgood detail</b>	Quickly generate more shape/CMF versions of a detail of a product.
<b>Find best ergonomic dimensions</b>	Give the dimensions based on given age, Pxx, region, etc.
<b>Summarize consults/discussions internal or external (IP, safety, compliance, etc.)</b>	Create transcripts and short summary, maybe with links to parts of the recorded sessions where full details of conversation can be found.
<b>Competition analysis</b>	Compare features.
<b>Boost ideation phase</b>	Generate multiple images with variations.
<b>AI rapid learning cycles</b>	Make sure we don't forget stuff, easily prioritize.
<b>Input a surface and get the files I need for KeyShot</b>	...
<b>Input basic info and get amazing templates for presentations</b>	...

## *Appendix C. Can AI-Generated Insights Be Trusted?*

While introducing InsightGPT to Bugaboo's design teams, I had to confront a fundamental question: can insights generated by AI be considered valid? More than a question of usefulness, this was about trust, and whether designers could rely on AI to support early-stage user research without compromising quality or nuance. Convincing skeptics required not just enthusiasm but evidence, and I undertook a parallel line of inquiry to evaluate InsightGPT's reliability.

This raised broader epistemological concerns. AI might be fast and scalable, but is its understanding of users deep enough to guide meaningful design decisions? Can it grasp cultural subtleties or interpret ambiguity the way a human researcher might? And crucially, how should AI be positioned in relation to traditional research? As a replacement, an assistant, or simply a conversation starter?

These questions are not only methodological but also ethical. Over-reliance on AI-generated insights risks detachment from the very users we aim to understand. Yet ignoring the power of AI to structure and surface latent patterns would be a missed opportunity. The challenge lies in finding the balance between critical human interpretation and computational efficiency.

### *C.1. Why AI Often Aligns with Human Research*

To answer these questions, it helps to understand how generative AI produces insights in the first place. As Hugo Alves, founder of Synthetic Users, explained in my interview with him, tools like InsightGPT don't invent, they synthesize. Their knowledge is rooted in the human-authored content they are trained on: social media discussions, product reviews, user interviews, and published studies. AI doesn't create a new worldview; it repackages fragments of the one we've already built.

Recent research supports this claim. A study by Park et al. (2023) tested AI's ability to simulate human behavior by training GPT-4 models on over 1,000 interview transcripts. These AI agents were then asked to complete follow-up surveys and behavioral tasks designed for the original participants. The results were striking: AI-generated responses aligned with the participants' own answers 85% of the time, even weeks later. The AI also performed reliably in predicting personality traits and behavioral outcomes while minimizing demographic bias.

This doesn't make AI infallible, but it does suggest that its value lies in structured generalization. It reflects collective human knowledge rather than inventing it, which makes it effective for common behaviors, mainstream user profiles, or widely discussed trends.

Still, accuracy is dependent on context. In fast-moving markets or niche demographics, generative models can lag behind or miss critical nuances. AI might capture what's generally true, but not necessarily what's uniquely relevant. That's why it's best viewed not

as a conclusive research tool but as a fast, flexible hypothesis generator. When used critically and in conjunction with human judgment, AI can meaningfully accelerate early-stage research, while leaving space for depth, empathy, and discovery.

### *C.2. Where InsightGPT Falls Short: Four Limits of AI in Design Research*

While generative AI-driven tools like InsightGPT can replicate many elements of user research with impressive speed and thematic accuracy, several critical limitations emerged through practice at Bugaboo. These gaps don't negate AI's value, but they do clarify the boundaries of its usefulness and reaffirm the necessity of human interpretation and real-world validation.

#### *C.2.1 AI Is Directionally Useful, But Not Quantitatively Precise*

One of the more misleading aspects of generative AI is its tendency to present numerical estimates with high confidence despite lacking access to statistically grounded data. In one benchmarking experiment at Bugaboo, InsightGPT estimated that 41% of parents would prefer an extended warranty. In reality, survey data showed only 28% agreement. The result was not an outlier. Across multiple comparisons, generative AI produced estimates that were directionally plausible but often quantitatively inaccurate.

What this reveals is a critical distinction: generative AI excels at qualitative synthesis, capturing the motivations, logic, and language that shape consumer behavior, but it lacks statistical rigor. Its "forecasts" are reflections of linguistic probability, not empirical distributions. Without human calibration, such figures should be treated as hypotheses, not evidence.

For designers, this means AI-generated numbers should be treated as directional cues, not factual data. While the AI can help sense trends, designers must verify with real-world studies before making decisions that rely on quantifiable preferences, such as cost/benefit trade-offs, feature prioritization, or business case assumptions.

#### *C.2.2 AI Misses Emotional Nuance*

Generative AI can identify common emotional themes, stress around stroller safety, delight in product convenience, but it struggles to perceive the emotional nuance that often emerges in live research. It may understand that urban parents worry about crowded sidewalks, but it cannot fully capture the embodied tension of a caregiver navigating a stroller down subway stairs while commuters rush past.

Human researchers pick up on the pauses, hesitations, and micro-reactions that shape understanding. Generative AI lacks this perceptual sensitivity. It cannot interpret the shift from frustration to satisfaction when a feature unexpectedly works well, nor can it spot the silent cues, body language, emotional ambivalence, that often provide the richest insights in user research.

For designers, this limits the AI's ability to support emotionally grounded decisions, particularly in areas like comfort, trust, or perceived value. Empathy-driven design still relies on direct observation and in-person research, where emotional nuance and body language provide essential cues.

### *C.2.3 AI Reflects, But Doesn't Reframe*

Because generative AI works through pattern recognition, it tends to reinforce dominant narratives rather than challenge them. In one example, InsightGPT identified a common preference among urban parents for compact strollers. On the surface, this was accurate. But human researchers discovered a deeper truth: many parents didn't want compact strollers, they needed them due to limited space or narrow hallways. When asked, they actually preferred larger, more comfortable models.

This is a critical limitation. Where human researchers often challenge assumptions, generative AI tends to reflect them. Without deliberate prompting, it rarely questions whether the observed behavior is a matter of preference or constraint. For reframing design problems, where breakthrough innovation often begins, human inquiry remains essential.

### *C.2.4 Only Humans Can Test in the Real World*

Perhaps the most obvious gap is physical testing. Generative AI can simulate usage scenarios, analyze reviews, and infer usability patterns, but it cannot push a stroller, fold a chassis, or feel the difference between a smooth glide and a sticky wheel. It cannot test how a canopy performs in the rain or how a handlebar feels in a caregiver's grip. These are interactions that must be experienced, not modeled.

Design decisions often hinge on subtle physical details, friction in a joint, ease of lifting, balance in motion, that AI simply cannot access. Human testers bring more than opinion, they bring embodied knowledge. They reveal unexpected ergonomic concerns, emotional reactions, and contextual dependencies that can't be fully captured in text or training data.



## Appendix D. Technology Acceptance Model (TAM) Evaluation

To evaluate how team members perceived and adopted the AI tools tested in this study—InsightGPT, CreAIte, and RulesGPT—I conducted a Technology Acceptance Model (TAM) assessment with key design and development stakeholders. Participants rated each tool across three dimensions:

- **Perceived Usefulness (PU):** How helpful the tool was in enhancing their work.
- **Perceived Ease of Use (PEU):** How easy the tool was to use.
- **Behavioral Intention (BI):** Whether they intended to use the tool in the future.

The following sections present an analysis of each tool’s TAM results, grounded in participant quotes and use-case reflections.

### D.1 .InsightGPT TAM Results

Participants used InsightGPT to explore needs, simulate cultural and regional perspectives, and test assumptions during early-stage development. Participants described its value in generating diverse user feedback and enhancing early ideation. Use cases included value proposition testing, concept validation, and scenario exploration. Perceived usefulness ranged from 2.00 to 4.75, with higher scores generally reported by those in strategic or research-oriented roles. Ease of use scores were generally moderate. Behavioral intention to use the tool was mixed, with responses falling between 2 and 4 (Table 12).

**Table 12.** *InsightGPT TAM*

Participant	Feelings & Use-Cases Quote	Avg. PU	Avg. PEU	BI
<b>Styling Product Lead Designer</b>	<i>(No quote provided)</i>	2.00	3.00	1
<b>Product Innovation Lead #1</b>	<p><i>“Excitement, especially when I start designing a new product. It’s always refreshing to explore different perspectives.”</i></p> <p><i>“Sometimes, due to my experience, I tend to limit my thinking, but AI helps me break through those barriers and consider new opportunities and use cases.”</i></p>	4.75	4.25	3
<b>Director of Product Innovation</b>	<p><i>“Helpful to get a better understanding of users/ parents all over the world. Also to understand cultural and behavioral differences ... I think it can definitely help ignite some new insights. Can't wait to put it to the test e.g. reflecting on some concept descriptions.”</i></p> <p><i>“Getting insights in users in other countries/cultures. Reactions on current products – why good or bad. Getting more variations in answers.”</i></p>	4.50	3.50	4
<b>Product Developer #1</b>	<i>“Very interesting to explore! Use case: quickly getting user feedback and input on their needs and preferences. It can help already in early concept phases.”</i>	3.25	2.50	2

	<i>"Reduce the risk of Bugaboo 'insiders' opinions &amp; preferences'. It can provide more subjective input to what is desired by consumers."</i>			
<b>Product Designer</b>	<i>"Interesting to get insights for products and their usage in especially in totally different regions/cultures."</i>  <i>"Get an opinion if feature A or B is more preferred for a user in that region, especially if we can't feature both in the product and have to choose."</i>	3.25	4.50	3
<b>Product Developer #2</b>	<i>"I would like it specifically to get new 'unexpected' insights. It looks very valuable already in scanning for different popular models, as in your demo for Japan. But it gets interesting to know why customers will choose one model over the other – e.g. on what specs – or whether there are other factors (like local price offerings) that are more difficult to detect. The tool looks useful overall."</i>  <i>"I need to have more experience with it first. Naturally, the question remains how far the AI will rephrase input into more obvious comments, or if it can also scan/detect/'feel' real insights."</i>	3.50	3.25	3
<b>Product Innovation Lead #2</b>	<i>"Value proposition testing."</i>  <i>"Initial validation of assumptions."</i>	4.25	3.50	4
<b>Product Developer #3</b>	<i>"I think it's a nice addition to current research and can help in making better use of 'static' documents. In early development, I see it as a useful tool to brainstorm and give insight, although I think it can be challenging to give the right prompts."</i>  <i>"I think it can give quick insights instead of having to read through piles of documents."</i>	3.50	3.75	4

## D.2. CreAIte TAM Results

CreAIte was used to quickly generate visual content during styling, inspiration, or ideation phases. Participants cited its potential for color and material exploration, creating image variations, and saving time during early design. Designers gave higher scores than developers, reflecting the tool's focus on visual outputs. Usefulness scores ranged from 2.00 to 5.00, with ease of use scores also generally high. Behavioral intention scores reflected perceived relevance to participants' roles and the quality of outputs (Table 13).

**Table 13.** CreAIte TAM

Participant	Feelings & Use-Cases Quote	Avg. PU	Avg. PEU	BI
<b>Styling Product Lead Designer</b>	<i>"Brings new possibilities when wanting to create quick visualizations, specially for accessories."</i>  <i>"Quick visualizations of ideas."</i>	4.25	4.00	4
<b>Product Innovation Lead #1</b>	<i>"Only beginning of the creation process, I would see the help of Midjourney, or for the color changing end of the process."</i>	4.50	4.00	3

	"Creating quick images for inspiration, cost saving if we can change the colors of the stroller for photoshoots :)"			
<b>Director of Product Innovation</b>	"Excellent tool to divert and create many different options and variations on existing models and pictures." "Uncertain about the outcomes. Need good prompts. Only good for first visualisations/feelings on directions."	4.00	3.75	4
<b>Product Developer #1</b>	"Surprising how fast this works! Use case: brainstorming / concept generation on Design styling (colors, materials) visuals." "As engineer, I will most likely not use this tool myself. But for the Design team this can be a great support to find the direction that they like quickly."	3.50	3.75	4
<b>Product Designer</b>	"Quick visualization of potential concepts. Get inspired by various outcomes." "From sketch or basic not-yet good-looking 3D model to nice render."	5.00	5.00	5
<b>Product Developer #2</b>	"I see it useful for visualizing of color versions, special collaborations etc. I would use it, for example, for hardware finishings in the technology roadmap group, probably starting from the photo library." "I don't know how useful it would be if the output of visuals is more conceptual."	3.75	3.00	3
<b>Product Innovation Lead #2</b>	"Exploring (variations) of concepts." "Quickly iterate and test ideas, getting surprised."	4.00	3.25	3
<b>Product Developer #3</b>	"Can help in quickly visualize new ideas/opportunities. Although at the moment I have my doubts about the quality of the output. This is the main reason I would not use it but I do see the potential when this would improve." "Quickly visualizing new product ideas."	2.00	3.25	2

### D.3. RulesGPT TAM Results

RulesGPT supported compliance-related tasks, such as checking regulatory requirements, referencing standards, and summarizing dense documents. Participants used it to look up information across regions and assess standards. Several noted the tool's speed in retrieving requirements, though some raised concerns about accuracy and the inability to interpret edge cases. Usefulness scores ranged from 2.00 to 5.00, with consistently moderate to high ease of use. Behavioral intention to use the tool was generally high, especially among those working with compliance and product validation (Table 14).

**Table 14.** RulesGPT TAM

Participant	Feelings & Use-Cases	Avg. PU	Avg. PEU	BI
<b>Styling Product Lead Designer</b>	"Very interesting but not relevant for my work."	2.25	3.00	3

<b>Product Innovation Lead #1</b>	<p>"Nice to use as a first feedback, brainstorming partner for my quick questions. We should still reach out Dean when the design gets more mature."</p> <p>"Easy to find things."</p>	4.75	4.75	5
<b>Director of Product Innovation</b>	<p>"Easy to get all requirements on certain topics together so you don't forget anything. Nice to see if it can actually judge based on pictures."</p> <p>"Overview and not forgetting requirements. Quickly search and find."</p>	3.75	4.25	4
<b>Product Developer #1</b>	"Finding relevant Compliance information within the huge amount of documents that we have, to determine if our Product design has potential risks that need to be reviewed."	3.75	3.75	4
<b>Product Designer</b>	<p>"Look up requirements. Should be citing/quoting and be very precise. Should make a difference between old, current and potentially also draft upcoming standards and not mix them."</p> <p>"Look up requirements quickly. Especially multi-region."</p>	5.00	5.00	5
<b>Product Developer #2</b>	<p>"It still cannot replace our in-house expert. Nice as a search tool, but also in a certain way dangerous – as it cannot think out of the box."</p> <p>"It will not scan yet outside of the existing compliance framework. Naturally, limitations of documents need to go away for it to work with the original standards too. Chemical compliance, new regulations, and sometimes local or consumer test country requirements evolving differently can be dangerous. The same goes for safety assessment – compliance checks are never enough."</p>	3.50	4.00	4
<b>Product Innovation Lead #2</b>	<p>"Low threshold to check compliance requirements."</p> <p>"Find answers on compliance related questions."</p>	2.00	3.00	2
<b>Product Developer #3</b>	"Making difficult-to-read compliance documents more accessible."	4.00	4.00	4

## Appendix E. Original Graduation Project Brief



Name student F.P.E. (François) Prévot

Student number 4,868,684

### PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

**Project title** AI Alchemy: Exploring Opportunities for AI in New Product Development at Bugaboo

*Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.*

### Introduction

*Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)*

This graduation project is a collaboration between Bugaboo International B.V., a Netherlands-based company known for high-quality strollers and the Designing Intelligence Lab in the TU Delft Faculty of Industrial Design Engineering. With over 800 employees in 21 countries and B-Corp certified since 2023, Bugaboo aims for Net Zero by 2035 and adheres to EU sustainability and ESG regulations, focusing on durable, innovative, and responsible products. The project aims to explore the intersection of design practices and artificial intelligence (AI) as part of the exploratory and early-stage new product development (NPD) processes, also called new concept development (NCD) at Bugaboo (see Figure 1).

Bugaboo is exploring how AI can enhance its product and service innovation. Research suggests AI can improve design practices in NCD processes like exploration and ideation (Bilgram & Laarmann, 2023), but it may also cause design fixation (Wadinambiarachchi et al., 2024) and be less effective in early co-creation (Hwang, 2022). While AI may boost creativity and efficiency, it may challenge the human touch, business continuity, and raise legal issues if not properly aligned with the business (Amankwah-Amoah et al., 2024). Given these nuances, this project aims to explore how AI can aid design practices within NCD by defining the conditions for its use, developing a strategy to support design practices within a team of designers, engineers, marketers, and managers, and evaluating its impact.

Limitations may stem from the current understanding of AI integration in design practices and processes, the use of proprietary company knowledge in AI tools, and trust concerns about AI-generated outputs.

→ space available for images / figures on next page

## introduction (continued): space for images

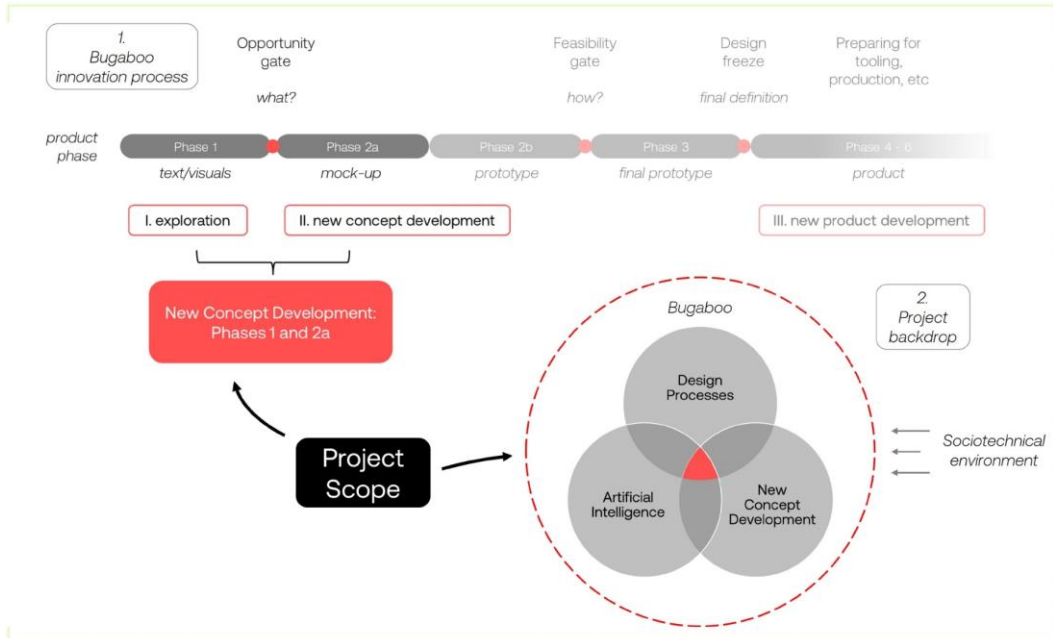


image / figure 1 The project's scope is at the intersection of design processes, AI and new concept development

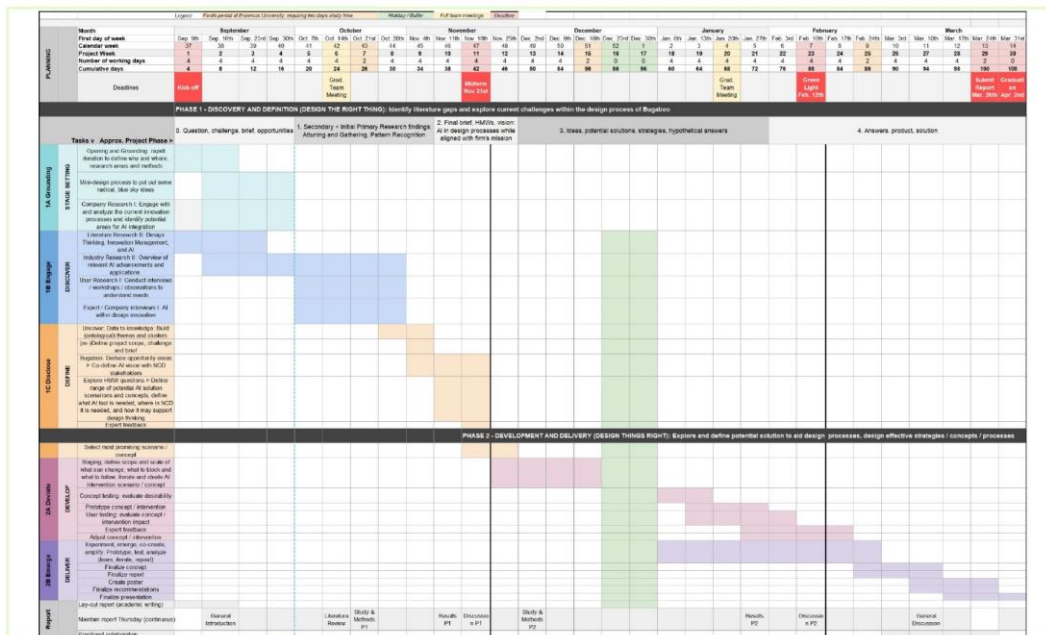


image / figure 2 Project Gantt chart showcasing two phases—discovery and definition (1), development and delivery (2)





## Personal Project Brief – IDE Master Graduation Project

### Problem Definition

*What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.  
(max 200 words)*

AI presents opportunities for enhancing creativity, streamlining workflows, and accelerating design practices but also introduces challenges such as maintaining the human touch, addressing legal and regulatory concerns, and managing potential impacts on creativity and business continuity (Amankwah-Amoah et al., 2024). Although these opportunities and challenges have been identified, there remains a significant knowledge gap in the literature on AI's role in the NPD/NCD processes, highlighting the need for further research. In their literature review, Mariani and Dwivedi (2024) noted that only two out of 98 reviewed articles examined how AI can augment or accelerate design innovation practices in NPD/NCD teams.

In the context of Bugaboo's current situation, the primary challenge is how to integrate AI into its design practices within the NCD processes effectively, while upholding its core values of durability, innovation, and responsibility. It is crucial to first understand Bugaboo and the NCD team's needs and criteria for AI integration in alignment with Bugaboo's processes, practices, and values. This understanding will guide the creation of a vision for responsible AI use to aid design practices within NCD processes, and the implementation of a use case demonstrating its feasibility. The key is to handle challenges iteratively while extracting AI's potential benefits.

### Assignment

*This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:*

Strategically explore opportunities for AI to aid design practices in exploratory and early-stage new product development processes, also called new concept development, for innovation teams at Bugaboo.

*Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)*

This project will be conducted in two phases. Since Bugaboo lacks an AI for design understanding and vision, Phase 1 (~40 days) will focus on creating this understanding to enable cohesive decision-making in the subsequent phase (Van Erp, 2011). (Van Erp, 2011). During this phase, I will quickly identify opportunities for AI applications, begin studying and documenting Bugaboo's practices and processes, and review relevant AI and design literature to define the problem and establish a solid foundation. The goal is to develop an overview of scenarios and a vision for AI in NCD. In Phase 2 (~60 days), this vision will be implemented through an initial AI application aimed at enhancing understanding within the research and supporting New Concept Development (NCD).

Summarized, Phase 1 will focus on discovery and definition through data gathering, literature review, desk research and engagement with Bugaboo's NCD team. Phase 2 will be dedicated to developing and delivering an AI solution or strategy to aid the design practices of the NCD team, utilizing prototyping and design-based research methods. Overall, I'm expecting a project with many iterations as the problem and solution space emerge and get defined. A flexible, responsive, and context-driven approach, using design methods as needed will be essential.

### Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).

Make sure to attach the full plan to this project brief.  
The four key moment dates must be filled in below

Kick off meeting	4 Sep 2024
Mid-term evaluation	21 Nov 2024
Green light meeting	12 Feb 2025
Graduation ceremony	2 Apr 2025

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	<input checked="" type="checkbox"/>
For how many project weeks	30
Number of project days per week	4,0

Comments:

Attending EUR Master in Management on Fridays. 30-week timeline based on a 4 day per week basis incl. a 2-week break and three 2 day weeks due to EUR finals periods.

### Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.  
(200 words max)

I am inspired by the notion that AI can help understand and transform design, and vice-versa. This project represents a unique opportunity to explore the exciting intersection of AI and early-stage design processes at Bugaboo. I am eager to dive into the ethical and practical challenges of integrating AI in a way that complements and amplifies human creativity while ensuring business continuity. By applying the skills from my Strategic Product Design program and Management degree—such as strategic and human-centered design, AI ethics, and innovation management—I aim to first of all understand and develop new knowledge to ultimately develop actionable strategies that harmonize technological progress with responsible use. I hope to not only showcase my ability to manage complex projects but also pave the way for a future where human ingenuity and AI can push the boundaries of design.

With regards to personal learning objectives, the main learning objectives in the graduation manual cover them thoroughly. As an intuitive individual, my primary challenges are communication, project management planning, and methods. My intuitiveness may not always align with structured approaches, which can make me appear indecisive when dealing with open-ended assignments. To address this, I plan to manage it by having frequent meetings to ensure clear communication and seeking consensus to establish priorities and seek guidance when needed. This approach will guide my planning with flexibility and balance emergent and planned methods and goals effectively.

For list of references to papers mentioned in this brief see letter: [Github.com/Bugaboo-graduation](#)



***Fin.***

