GENERATIVE ARTIFICIAL INTELLIGENCE (GAI) AND *DESIGN SPRINT*: A CASE STUDY IN THE CONCEPTUAL PHASE OF THE PRODUCT DEVELOPMENT PROCESS (PDP)

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Abstract: This article presents a case study on the application of a framework that integrates generative artificial intelligence with agile approaches (Design Sprint) to stimulate creativity in the conceptual phase of the product development process (PDP). The rapid evolution of AI tools and their increasing incorporation into the field of design have significantly expanded the possibilities for innovation, especially in the ideation stage. However, despite this potential, the guidelines that guide, in a structured way, the integration between AI and agile methodologies are still limited, which limits their practical applicability in real development scenarios. Given this gap, the present study investigated how the combination of generative AI and the design sprint methodology can support the generation of ideas in the initial phase of the PDP. For this purpose, an experimental framework was developed and applied based on this integration. The methodology adopted was qualitative and exploratory, with data collection performed through the analysis of results and the systematic recording of interactions with AI tools, including Ideogram, Vizcom, ChatGPT, and Hyper3D. The proposed challenge involves solving real design demands via the developed framework. The results showed that the presence of AI in the process contributed significantly to expanding the variety of ideas generated, reducing the time of conception, and promoting more strategic reflections on the solutions developed. It was also observed that the structure of the framework provided clarity, focus, and greater engagement during ideation, favoring co-creative practices. The analysis of the experience showed that the integration of AI into the design sprint is promising, especially when there is a balance between creative autonomy and the contributions provided by intelligent tools. The proposed framework represents an advance in the systematization of the use of AI in the ideation phase of the PDP, with the potential to strengthen more agile, innovative, and effective practices in the development of new products.
Keywords: Product development, artificial generative intelligence, ideation, conceptual project and design sprint.
Abbreviations: PDP, product development. GenIA, generative artificial intelligence.

1. Introduction

The development of new products (New Product Development - NPD) has become increasingly challenging because of the growing demands for agility, differentiation and innovation in a highly competitive market. Companies that seek to stand out need to accelerate their development cycles, meet the expectations of the most demanding users and, at the same time, create creative, viable and value-added solutions. In this context, artificial intelligence (AI), especially its

Generative technology has emerged as a strategic technology capable of directly supporting the ideation phase in the product development process (PDP).

Tools based on generative AI, such as *Midjourney*, DALL·E, Runway ML, Vizcom, Hyper3D, ChatGPT, and Ideogram, and integrated platforms, such as Adobe Firefly and Microsoft CoPilot, have been used to accelerate creative processes, generate visual alternatives, prototype concepts and support real-time decision making. This transformation is in line with the growing movement identified in scientific literature: recent studies have shown a significant increase in publications related to AI, creativity and design since 2019, which highlights the maturation of this field and its practical relevance (Furtado; Soares; Furtado, 2024).

Despite technological advances and the recognition of the potential of generative AI, its adoption in the PDP is still limited. According to McKinsey (2023), only 13% of companies apply AI in the development of new products, and 4% of them use tools to generate new product designs, which indicates that although the adoption of artificial intelligence (AI) is still relatively low in the context of the development of new products, companies that have incorporated this emerging technology into their innovation process have shown superior performance, standing out in the market(COOPER, 2024).

In 2024, 36% of companies use generative AI to generate McKinsey images (2024), which corroborates the finding that professionals have increasingly appropriated emerging tools to support the creative process in projects.
These data were extracted from research conducted by the world-renowned institution McKinsey (2023), which stands out for the production of high-impact applied research, involving topics such as digital transformation, innovation, and corporate strategy, productivity and emerging technology. His studies combine analytical rigor, access to large volumes of market data and collaboration with leading companies in various sectors of the economy.

The use of tools based on artificial intelligence has progressively intensified, driven by the wide availability of new platforms and the increasing integration of AI into business processes. However, despite these advances, there is still no consolidated systematization of the use of these technologies linked to a clear and validated methodology that effectively supports the creative process. This limitation is due not only to the empirical adoption of AI by companies but also, above all, to the absence of well-defined guidelines, structured methodologies and specific criteria that guide its integration into the product development process (PDP).

Given this strategic gap, this study proposes investigating how the integration of generative AI and agile methodologies can systematically support the ideation process in the conceptual phase of product development. The research starts from the construction and application of an experimental framework based on the design sprint methodology, exploring its ability to generate creative ideas, evaluate proposals efficiently and optimize the time and quality of decisions in real project contexts.

2. Artificial Intelligence in the Conceptual Phase

The application of artificial intelligence in the conceptual phase has been consolidated as one of the most promising fronts for stimulating creativity and expanding the repertoire of solutions in the product development process. In particular, approaches based on evolutionary algorithms and neural networks have allowed the exploration of innovative methods and the simulation of multiple scenarios in the initial phase of the project, when the requirements are still under construction. According to Castro Pena et al. (2021).

Liu et al. (2024) investigated the integration of artificial intelligence-generated content (AIGC) tools, such as Midjourney and Claude, in the design ideation phase. With respect to 119 students with different levels of proficiency, the experiment was applied in four disciplines guided by the process of *design thinking*. The intervention occurred especially in the ideation stage, in which students used AI to generate and refine conceptual sketches from prompts. The results revealed a significant increase in self-efficacy, the volume of ideas, originality and the diversity of proposals, although with a slight reduction in the final quality of the concepts. The research concluded that the pedagogical use of CGIs can enhance creativity and learning, as long as it is balanced with the development of critical thinking and student autonomy.

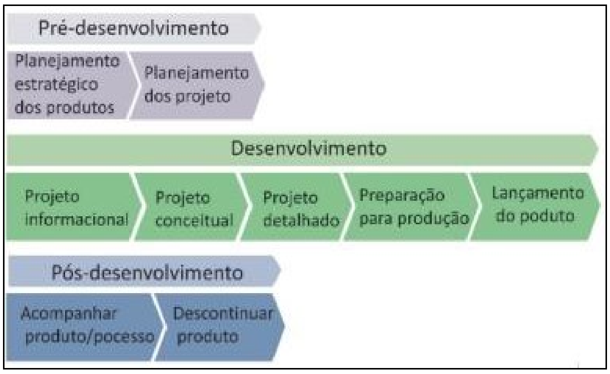
A case study focused on improving the conceptual ideation process through the integration of two techniques based on artificial intelligence: a semantic ideation network and a model of a combination of visual concepts via generative adversarial networks (GANs). The methodology involved two groups (a control group and a treatment group), each consisting of 12 participants, for a total of 24 individuals. The participants were instructed to design a spoon inspired by natural elements (such as a leaf, banana or carrot) and received visual and semantic stimuli generated by the AI tools during two ideation sessions. Performance was evaluated on the basis of four metrics: quantity, variety, novelty and quality of the ideas generated. Compared with the control group, the treatment group, which used the AI-based model, generated 48% more ideas, with 75% more variety and higher quality and novelty scores. This approach has been shown to be effective in stimulating creativity (Chen et al., 2019, p. 10).

One of the recent advances in image generation via AI is the incorporation of detailed semantic information, such as categories or attributes of the described entities, into the process. This type of approach allows the generation of images with greater alignment between the visual content and the textual description, overcoming the limitations of previous models that ignore this information and, consequently, produce results that are less precise or inconsistent with the original utterance (Zhou et al., 2021).

3. Product development process

The product development process (PDP) is a structured set of steps that aims to transform user needs and market opportunities into tangible solutions. According to Rozenfeld et al. (2012) and Baxter (2021), the PDP is composed of informational, conceptual, preliminary, detailed, prototyping and manufacturing phases. The conceptual phase stands out for demanding a high degree of creativity.

Figure 1. Project development flow.



Source: Rozenfeld 2012.

Product development involves a structured set of cyclical and interdependent activities aimed at transforming a market need or opportunity into a viable product. Given the complexity of this process, which includes technical, functional, ergonomic, marketing and social requirements, it is necessary to use methodologies capable of guiding decision-making in each phase of the project.

The product development process (PDP) is a systemic model structured in three macro phases: predevelopment (defining portfolios and strategic objectives (defining portfolios and strategic objectives), development (involving the conception, detailing and preparation of production) and post development (including monitoring of the product and its discontinuation), Rozenfeld et al. (2012)

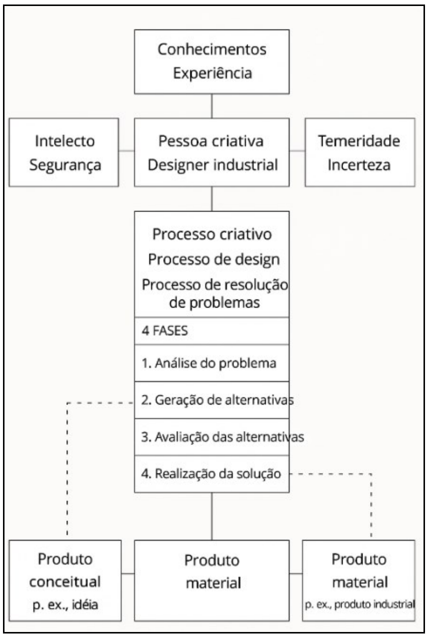
3.1. Problem-solving process

According to Lobach (2001), the design process is composed of four phases: problem analysis, where information about the relationship of the product with its context is collected and analyzed; identifying deficiencies and defining the problem; generating alternatives; a creative phase, in which several solutions are proposed without restrictions; exploring methods such as trial and error or inspiration; evaluating alternatives, in which the most viable solution is chosen on the basis of functional, social and economic criteria; and, finally, realizing the solution, with the construction of a prototype that brings together the strengths of the best ideas developed, which is continuously improve

"Design is the process of adapting an artificial environment to the physical and psychological needs of men in society." (LÖBACH, 2001, p.13)

Löbach places the user at the center of the design process, emphasizing the importance of understanding their needs, aspirations, context of use and symbolic relationship with the product. He emphasized that the designer must act as a mediator between the interests of the industry and human values.

Figure 2. *Design* process.



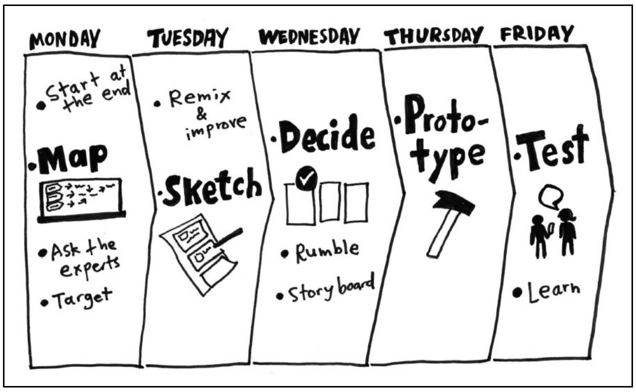
Source: Lobach (2001, p. 140)

3.2. *Design Sprint*

The *design sprint* methodology, developed by Jake Knapp and used by *Google Ventures*, presents an agile and intensive approach that aims to solve complex problems and test innovative ideas in just five days. Structured in five sequential phases, this methodology allows interdisciplinary teams to move quickly from understanding the problem to validating solutions, condensing the equivalent of months of work into a single week. This model reduces risks, promotes focus and saves resources, being especially useful in contexts of uncertainty or when strategic decisions need to be made quickly (KNAPP et al., 2016).

Throughout the sprint, each day is dedicated to a specific step. On Monday, the problem is understood, and the focus of the sprint is defined. On Tuesday, the team proposed individual solutions in a structured manner. Wednesday is dedicated to choosing the best ideas and drawing up a storyboard. Fifth, a high-fidelity prototype with a realistic appearance is developed. Finally, on Friday, this prototype is tested with real users, allowing for feedback.

Figure 6. Agile Methodology: *Design Sprint.*



Source: Jake Knapp (2017, p. 24)

4. Application and Results of the Framework

The *framework* was structured in five steps, with a total duration of two hours, distributed and consecutive, with the objective of supporting the conceptual phase of product development through the integration of generative artificial intelligence tools and the agile approach of the design sprint. In the first stage, which lasted twenty minutes, the process began with the definition of the design challenge and the construction of visual references via the ideogram tool, which aided in the creation of thematic and inspirational moldboards. In the second stage, which lasted thirty minutes, ideas and initial sketches were generated, using manual or digital sketch techniques to materialize exploratory concepts on the basis of previously constructed references (this stage can be inserted into *sketch* generation through the ChatGPT; however, it is optional); on the other hand, it is in this phase that cocreation takes place, as the designer elaborates creative ideas from their drawing skills to guide the originality of the proposal. In the third stage, which lasted thirty minutes, the selected sketches were rendered with high fidelity via the Vizcom tool, which, through visual prompts, translated the drawings into refined, realistic images of the design. In the fourth stage, which lasted ten minutes, the rendered visual proposals were transformed into virtual three-dimensional prototypes via the Hyper3D tool, allowing volumetric and spatial visualization of the developed concepts. Finally, in the fifth stage, which lasts thirty minutes, the design solution using the proposed framework was evaluated on the basis of the aesthetic attributes of the solution in terms of the user experience, clarity and AI contribution to the creative process.

The objective of the challenge was to develop a sports sunglasses project aimed at athletes and urban cyclists, with a focus on eye protection, performance and integration with technology. The target audience includes men and women between 25 and 40 years old who are sports practitioners with an urban profile and interest in technology.

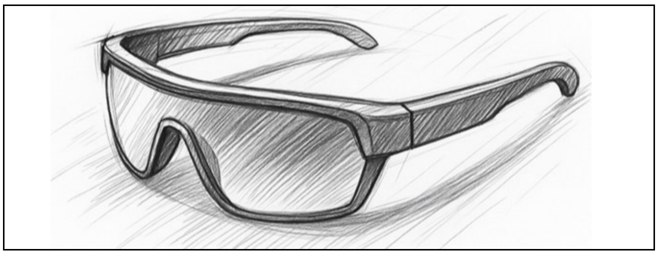
4.1 Presentation of results and reflection

Figure 9. Result of moodboard (step 1).

Source: own

To support the generation of images through AI, the use of an objective *prompt* that translates the taxes of the product was guided. The first step prompts the generation of a *moodboard* image with a variety of images featuring modern material, innovative design, colorful, user, sporting environments and everyday elements. For this stage, the *artificial intelligence ideogram was used.*

Figure 10. Result of *sketch* (step 2).



Source: own

At this stage, the methodology does not require the use of an AI, as the intention is to keep the design in control of the generation of ideas. However, there is the possibility of using AI, such as ChatGPT or *Midjourney,* in the early stages.

Figure 11. Result of the alternatives (step 03).

Source: own

To realistically represent the solution, texture, volume, finish, material and graphic elements were applied. For this stage, the artificial intelligence *vizcom was used.*

The *prompt* of the third stage generates an image of a sporty sunglasses [object], innovative, green, sporty design [characteristics], that meets the challenge and aesthetic attributes and attaches the selected sketch [ideation].

Figure 12. Result of the virtual prototype (step 04).

Source: own

In this stage, the Hyper3D tool was used as an artificial intelligence resource for the generation of the three-dimensional model. For simplicity, the image shown in Figure 11 was attached to the platform, which automatically converted the visual content into a 3D model in the OBJ format.

Figure 13. Design variations

Source: own

5. Results and conclusion

This step aims to evaluate the application of the framework outlined in step 05. The results demonstrated that the solution effectively met the objectives of the proposed challenge, shining in several key areas: (i) Addressing the challenge: satisfying the requirements of the proposed brief, (ii) relevance to the target audience (young individuals aged 25 to 40, urban athletes interested in technology), (iii) aesthetic coherence with attributes of innovation, sportiness, and functionality, (iv) efficiency in the creative process, as all stages were completed in just two hours, highlighting the potential to expedite the conceptual phase of the Product Development Process (PDP), and

(v) generation of multiple alternatives (various versions of eyewear designs were developed, broadening creative diversity and enhancing decision-making).

The application of generative artificial intelligence in the conceptual phase of the product development process has proven promising, especially when integrated with agile methodologies such as design printing. The results observed throughout the study show that AI is capable of significantly expanding the creative capacity of designers, offering new possibilities for generating visual alternatives, sketches, prototyping and evaluating proposals. Among the main positive aspects, the following stand out: (i) the acceleration of the ideation process in a consistent manner, allowing the generation of multiple solutions and a reduction in development time; (ii) the expansion of the creative repertoire through visual and conceptual suggestions generated from specific data; (iii) increased efficiency and productivity during product design; (iv) meeting the objective of the challenge and meeting the requirements of the aesthetic attributes and target audience; (v) a low entry barrier for technical use, democratization of access; (vi) stimulation of divergent thinking, promotion of exploratory thinking; (vii) reduction in creative block; and (viii) the integration of cocreation between human intelligence and artificial intelligence. In addition, the use of AI contributed to more strategic reflections on solutions and increased engagement in the creative process.

This study also identified some points for improvement. Among the main points, the following stand out: (i) difficulties in representing the signage and visual communication elements (brand and icons); (ii) need for postprocessing of the design (image adjustment); (iii) refinement needs in the 3D model; (iv) nonfunctional virtual prototype and (v) dependence of the prompt quality on image generation.

6. References

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