03.

Co-Design Sessions at Revigrés: Workshop 4.0 as the Final Step Towards Design-Led Innovation

*Sessões de co-design na Revigrés:
o Workshop 4.0 como etapa final para a consolidação da inovação orientada pelo design*

Gisela Pinheiro
ID+, DeCA, Universidade de Aveiro
grpinheiro@ua.pt

Teresa Franqueira
ID+, DeCA, Universidade de Aveiro
teresa.franqueira@ua.pt

Este artigo apresenta os resultados e as conclusões do Workshop 4.0, o evento culminante de uma série de sessões de cocriação realizadas na Revigrés, um produtor português do sector dos azulejos cerâmicos. O Workshop 4.0 centrou-se no aperfeiçoamento de protótipos e na validação das necessidades dos utilizadores e dos objetivos da empresa, funcionando como um momento crucial no percurso da organização rumo à consolidação de uma inovação orientada pelo design.

Através de um programa abrangente, composto por 14 atividades ao longo de quatro horas, os participantes envolveram-se em esforços colaborativos com a intenção de aprimorar conceitos de produto e recolher feedback.

As principais conclusões do Workshop 4.0 destacam: a importância da experimentação estratégica e da validação no processo de design; o papel orientador do facilitador no alinhamento da função do design com os objetivos estratégicos da empresa; e os benefícios significativos alcançados em termos de inovação, através do foco na sustentabilidade e num design cen-trado no utilizador. O workshop promoveu ainda a valorização da cultura de design na organização, facilitando a colaboração interdepartamental e a partilha de conhecimento entre colaboradores de diversas áreas, contextos sociais e percursos educativos distintos.

Ao adotar os princípios e práticas do design thinking nesta atividade, a Revigrés adquiriu conceitos que poderão ajudar a posicionar a empresa como um agente de inovação no sector cerâmico. Integrada numa investigação de doutoramento em curso, realizada em parceria com a Revigrés, esta iniciativa experimental visa capitalizar os resultados e conhecimentos gerados no Workshop 4.0 para institucionalizar o design thinking em toda a organização, promovendo uma cultura de inovação contínua e crescimento sustentável nos próximos anos.

Este artigo contribui com perceções relevantes para organizações que procuram potenciar a inovação orientada pelo design como resposta a desafios complexos e como motor de mudança significativa nos sectores em que operam.

Palavras-chave inovação orientada pelo design, cultura corporativa, estratégia organizacional.

This article presents the findings and insights gleaned from Workshop 4.0, the culminating event in a series of co-design sessions held at Revigrés, a leading Portuguese manufacturer of ceramic tiles. Workshop 4.0 focused on refining prototypes and validating user needs and company objectives, serving as a pivotal moment in the organization's journey toward design-led innovation. Through a comprehensive program comprising 14 activities spanning over four hours, participants engaged in collaborative efforts to refine product concepts and gather feedback for iterative refinement.

Key insights from Workshop 4.0 include the importance of strategic exper-imentation and validation in the design process, the facilitator's guiding role in aligning design efforts with strategic goals, and the significant inno-vation gains achieved by Revigrés through a focus on sustainability and design that addresses user needs. The workshop also facilitated the cultivation of a design culture within the organization, fostering cross-functional collaboration and knowledge sharing among employees from diverse departments and backgrounds.

By embracing design thinking principles and practices, Revigrés gained concepts that can help position the company as a player in innovation within the ceramics industry. As an integral segment of ongoing doctoral research in collaboration with Revigrés, this exper-imental initiative aims to capitalize on the insights gained from Workshop 4.0 to institutionalize design thinking company-wide, driving continuous innovation and sustainable growth in the years to come. This article provides valuable insights for organizations seeking to harness the power of design-led innovation to address complex challenges and drive meaningful change in their industries.

Keywords *design-led innovation, corporate culture, organizational strategy.*

1. Introdução

1.1. Building Design-Led Innovation at Revigrés: A Journey of Co-Creation

This study fits into the scope of ongoing Ph.D. research led, aiming to explore and affirm the role of a Chief Design Officer (CDO) in a corporate environment, having Revigrés as a platform for strategic experimentation.

In the prototyping length of the Ph.D. research, a series of four co-creation design sessions were organized by the research team, engaging various stakeholders from industry, retail, and research fields. Under the format of workshops, they were designed with a focus on innovative product development, and leveraged design principles, techniques, and methodologies to explore two distinct themes within the context of Revigrés, a prominent Portuguese manufacturer of ceramic tiles. The overarching goal of these sessions was to experiment with how to drive design-led innovation and to show the potential strategic role of a CDO within the company. Held between January and May 2023, in three different locations, these workshops aimed to test key assumptions, foster a design-oriented culture, and develop groundbreaking concepts that could shape Revigrés' future product range.

Since these activities are part of a study in which the goal is to assert the CDO role in businesses, the research team approached the workshops with specific assumptions to validate. Previous studies and activities such as case studies and interviews have shown some practices applied in the design function of companies like Philips, 3M, PepsiCo, and J&J, led by CDOs [1; 2; 3]. The inputs gathered in these studies and the literature review prompted several research questions and hypotheses that have since been tested by the research team.

The first assumption aimed to explore how the CDO's strategic responsibility for evolving the product range could lead to more creative solutions and broaden the company's offerings. The second assumption examined whether the CDO's role in educating stakeholders about the value of design would enhance their understanding of the design function and its activities. The third assumption sought to determine if open communication with multidisciplinary participants in the design process could improve creativity and lead to more innovative concept generation. Finally, a fourth assump-tion delved into the challenge of embedding and scaling up a design culture within the organizational context, making it a key goal for the CDO.

Furthermore, in the organizational context of Revigrés, the Co-Design Sessions emphasized two central themes devised by the research team. The first theme focused on the development of kinetic energy ceramic tiles, exploring how this technology could enhance the product range and boost the company's innovative performance. The second theme, centered around "smart tiles", sought to envision new products, services, and experiences integrated into intelligent ceramic tiles that optimize spaces and fulfill multiple functions. These themes emerged from the research team's design vision to develop multi and plural-function products for Revigrés, as a catalyst of innovation aligned with the strategic guide-lines defined to implement a design function within the business environment.

These themes embedded in the Co-design sessions were aligned with the assumptions related to the leadership role of the CDO. Specifically, they test how to rapidly prototype to expand the company's offerings and range of products through design-led processes and innovative concept generation. The construction of the sessions also aimed to educate stakeholders about design processes by incorporating design thinking tools and mindsets into the equation. This approach aimed to achieve quick concepts within the four sessions, ultimately leading to a showcase of the value that design can bring to a company.

2. Research Methodology

This study explores the experimentation of a process of building design-led innovation at Revigrés through a journey of co-design and multidisciplinary workshops, according to the following research methodology.

The co-design sessions were promoted both within the university where the doctoral research undergoes and within Revigrés. The workshop promotion included a detailed description of the objectives of the co-design sessions, the specific objectives of each workshop, the agenda, duration, location, and facilitators' descriptions.

For the university participants, enrolment was open to students, teachers, and researchers from any course or degree. The workshop had a limited capacity of 15 seats and the selection process was based on a first-come-first-served basis. The aim was to encourage a diverse range of perspectives and expertise among the university participants.

For Revigrés' employees and stakeholders, the remaining half of the workshop seats were reserved. The selection process for this group was based on nominations and recommendations from the company's management to ensure representation from different departments and roles within the organization.

The research methodology adopted a mixed-methods approach, integrating qualitative and quantitative data collection methods to gather comprehensive data on the impact of design thinking and the role of CDOs in enhancing the innovation process within the company. Data was collected through participant observation, feedback surveys, and interviews.

The research applied a sequential exploratory strategy, which involved an initial qualitative phase (participant observation, document analyses, and interviews) followed by a quantitative phase (feedback surveys) to corroborate the qualitative findings. This approach allowed for a holistic un-

derstanding of the co-creation process and the participants' perspectives. The main data collection methods were:

- Participant Observation: participant observation was conducted during the co-design sessions to capture real-time interactions, collaboration, and problem-solving processes among the participants. This method allowed the researchers to immerse themselves in the co-creation environment, facilitating and gaining deep insights into the dynamics of the workshops, the facilitation process, and understanding the participants' experiences and interactions.
- Interviews: Semi-structured interviews were conducted with some participants, including Revigrés' employees, students, researchers, and workshop staff, to gather in-depth insights into their perceptions, experiences, and learnings from the co-design sessions. These interviews explored participants' attitudes toward design thinking and the impact of the workshops on their creative thinking.
- Feedback surveys: post-workshop surveys were administered to assess participants' satisfaction with the co-design sessions, the effectiveness of the design thinking methodologies, and their perceptions of the value of design-led innovation at Revigrés. Questions like "What worked well?", "What could be improved", "Ideas?" and "Questions?" were set.
- Document Analysis: Documentation of the co-design sessions, including canvases, brainstorming results, and prototype designs, was analyzed to identify themes, patterns, and innovative concepts that emerged from the workshops. Document analysis provided valuable qualitative data that complemented the interview and survey findings.

Qualitative data from participant observations, interviews, and document analysis were analyzed. The data were transcribed, coded, and categorized into themes and patterns, capturing participants' experiences, challenges, and creative outputs during the co-design sessions. The quantitative data from feedback surveys were analyzed using descriptive statistics, providing insights into participants' overall satisfaction and perceptions of design thinking methodologies.

Triangulation was employed to ensure the validity and reliability of the research findings. Data triangulation involved cross-verifying information from multiple data sources, including participant observation, interviews, surveys, and document analysis. The convergence of findings from different data collection methods added credibility to the research outcomes and was converted into infographics to be communicated to the company and design community.

Ethical considerations were given due importance throughout the research process. Informed consent was obtained from all participants before data collection. Anonymity and confidentiality were ensured to protect participants' privacy and identities. The study complied with the ethical guidelines outlined by the company ethics board.

The research faced some limitations, including a significant diversity of participants, which may limit or influence the generalizability of findings. Additionally, the four-hour duration or even the different participants per challenge of each co-design session may have constrained the depth of insights that could be obtained. Nevertheless, efforts were made to mitigate these limitations and draw meaningful conclusions from the available data. Each workshop data analysis helped to improve the next one, contributing to a continuous improvement in the facilitation procedure and in the session structuring.

3. Design Thinking for Validation and the role of the CDO

The literature on design thinking underscores its transformative potential in fostering innovation within organizations. Design thinking, characterized by its iterative nature and emphasis on empathy, collaboration, curiosity, and experimentation, has emerged as a powerful methodology for addressing complex challenges and driving creativity [4; 5].

Previous studies, examining central case studies like Philips [3], have highlighted design thinking as an approach exploited by CDOs to lead design teams and foster innovation within companies. Notably, approximately 50% of organizations outperforming the S&P 500 had CDOs [6].

Liedtka's [7] research underscores the transformative potential of design thinking in fostering innovation, enabling organizations to unleash creative energies, win employee commitment, and improve processes. By reframing problems, embracing experimentation, and leveraging diverse teams, design thinking circumvents human biases and entrenched behavioral norms that impede imagination.

Other literature on design thinking often delineates a blend of elements, tools, and approaches necessary for its realization for both individuals and organizations [8]. Academic and practitioner-oriented publications typically outline ideal design thinking attributes and conditions, encompassing various facets such as empathy, collaboration, curiosity, experiential intelligence, consciously creative approaches, acceptance of uncertainty, and critical questioning [9].

Empathy plays a pivotal role in design-led innovation, facilitating the creation of emotion-rich innovations based on understanding users' needs and experiences [10]. Defined as the ability to see and experience through another person's eyes, empathy is central to the design thinking process, enabling practitioners to embody and enact a deep understanding of user perspectives [11].

Collaboration is another cornerstone of design thinking, entailing the integration of interdisciplinary teams to navigate the complexities of innovation projects [12]. Being collaboratively geared involves seamlessly integrating with diverse teams, embracing individual differences, and fostering an environment conducive to knowledge sharing and idea devel-opment [13].

An inquisitive mindset, coupled with openness to new perspectives and learning, characterizes DT practitioners' approach to managing uncertainty [14]. This mindset drives exploration, experimentation, and continuous feedback gathering, facilitating rapid problem-solving and a deeper understanding of customer and market contexts [15].

Experiential intelligence underscores the preference for hands-on experimentation and iterative prototyping in design projects [16]. By creating tangible representations of ideas, practitioners can test assumptions, solicit feedback, and iterate towards optimal solutions [17]. Furthermore, sharing ideas with a diverse audience is essential for gathering feedback and refining concepts. Actively seeking input from others enables teams to leverage collective intelligence and identify blind spots and by viewing others as co-collaborators rather than mere recipients of ideas, teams can foster a culture of openness and collaboration [18].

Conscious creativity permeates the design thinking process, as practitioners leverage creative methods and expressions to explore and communicate abstract concepts [19;20]. Encouraging others to embrace creativity fosters a culture of innovation and empowers individuals to contribute novel ideas [21]. Moreover, acceptance of uncertainty and openness to risk are essential traits in design thinking, as practitioners navigate complex and ambiguous problem spaces [22]. This entails making decisions based on future potential rather than past certainties, embracing the inherent risk of venturing into uncharted territories [23].

Critically questioning assumptions and insights is fundamental to the design thinking mindset, ensuring that ideas are rigorously evaluated and refined [11]. By fostering an environment of open-minded inquiry, practitioners can challenge conventional wisdom and arrive at more impactful outcomes [17].

The integration of empathy, collaboration, curiosity, experiential intelligence, active engagement with diverse perspectives, conscious creativity, acceptance of uncertainty, openness to risk, and critical questioning forms the foundation of design thinking practices. These elements are essential for teams to champion in the realms of design and innovation. However, the successful implementation of design thinking faces challenges associated with problem framing, user involvement, and organizational dynamics. Overcoming these challenges induces strong leadership to champion design thinking principles and cultivate a culture of innovation within organizations. Thus, by fostering an environment that embraces these core characteristics and addresses the obstacles encountered, organizations can harness the full potential of design thinking to drive meaningful and impactful innovation.

4. Workshop 4.0: Refining Prototypes and User Validation at Revigrés

Workshop W4.0 served as the culminating event in the Co-design Sessions at Revigrés, representing the final stage in the iterative design process focused on validating and optimizing prototypes. It took place on May 10th, 2023, within the premises of Revigrés, embodying a collaborative effort among diverse stakeholders to refine and enhance product concepts generated in preceding sessions. With a comprehensive program comprising 14 activities spanning over 4 hours, Workshop W4.0 aimed to leverage user feedback and real-world testing to validate assumptions and iterate on design solutions.
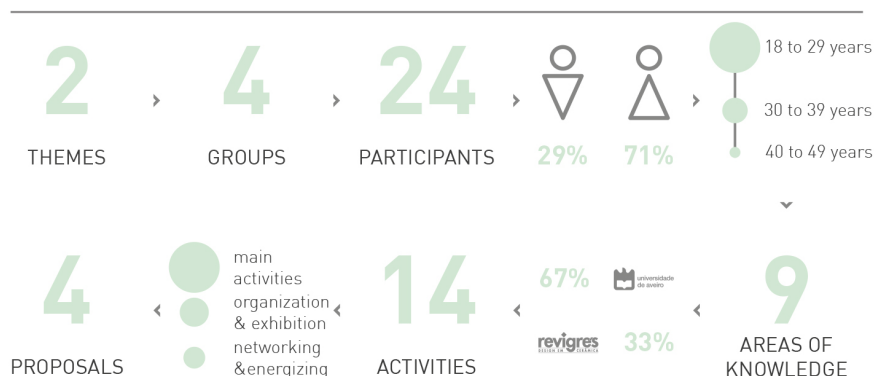
4.1. The Attendees

Workshop W4.0 brought together a total of 27 participants, spanning various age groups from 20 to 49 years old, reflecting a diverse range of expertise and backgrounds, as exhibited in figure 1. Participants included individuals from Aveiro University, primarily students and researchers, as well as employees from Revigrés. Notably, the workshop saw a strong representation from design professionals, underscoring the importance of design-led innovation within the context of Revigrés' operations.

Participants brought expertise from diverse fields, including design, commercial, marine sciences and technologies, chemical engineering, finance, marketing, production, quality, and research and development management. Team configurations mirrored the themes explored in previous Co-design Sessions, with two distinct challenges - Smart Solu-tions and Kinetic Tiles - serving as focal points for teams A and C, and teams B and D, respectively. Each team comprised six members, ensuring a diverse skill set and perspective within each group. To maintain fairness and diversity, participants who attended multiple workshops were assigned to different proposals, preventing overlap and fostering fresh insights and ideas.

Figure 1. Workshop 4.0 in numbers (source: authors).

W4.0: VALIDATION

2 THEMES › 4 GROUPS › 24 PARTICIPANTS › 29% 71% › 18 to 29 years / 30 to 39 years / 40 to 49 years

4 PROPOSALS ‹ main activities / organization & exhibition / networking &energizing ‹ 14 ACTIVITIES ‹ 67% universidade de aveiro / revigres 33% ‹ 9 AREAS OF KNOWLEDGE

4.2. Program and Methodologies

The workshop program, comprising 14 activities over a 4-hour duration, was methodically designed to guide participants through the process of prototype validation and concept refinement. The workshop program commenced with a 30-minute introductory action, providing an overview of the design process, methodologies, and objectives. Following this, an ice-breaking activity using Story Cubes fostering creativity and collaboration and team formation was seized.

A 20-minute brainstorming activity allowed participants to analyze challenges, interpret previous proposals, and gener-ate new concepts, drawing upon insights from previous workshops. A voting exercise enabled teams to prioritize ideas for further development, ensuring alignment with user needs and company objectives. The hunting plan activity facilitated strategic planning for prototype development, guiding teams in translating concepts into tangible prototypes.

The prototyping activity provided teams with dedicated time and resources to create prototypes that embodied their concepts and ideas, where participants were encouraged to leverage a diverse range of prototyping materials and tech-niques to bring their visions to life.

A brief coffee break provided opportunities for networking and informal discussions, fostering a sense of community and camaraderie among participants.

After prototyping the concepts, participants were challenged to prototype the way they would be leading and testing experience, where teams planned and executed experiments to validate their prototypes with potential users. This exercise underscored the importance of user feedback in refining and validating product concepts, highlighting the iterative nature of the design process.

A key highlight of Workshop W4.0 was the validation and conclusions exercise which also marked the culmination of the workshop, where volunteers from Revigrés provided feedback on the prototypes developed. This real-world validation served to validate assumptions and refine concepts, ensuring their viability and market potential. In this 40-minute exercise 10 to 15 volunteers from Revigrés were invited to provide feedback on the prototypes, mirroring users' needs, difficulties, and aspirations, validating or questioning assumptions, and refining concepts developed in workshop 4.0.

The session concluded with a 20-minute presentation from each team, showcasing their concepts, prototypes, insights, results, and conclusions, followed by a feedback exercise and a wrap-up moment done by the facilitator, allowing for reflections on the Co-design sessions experience.

4.3. Space Organization, Ambiance, and Materials

Hosted at Revigrés, the workshop's ambiance was carefully curated to foster creativity and collaboration, with the venue divided into designated workspaces for each team. The spatial organization, combined with thoughtful materials and narratives constructed by the facilitator, created an environment conducive to ideation and experimentation. Prototyping materials, including wires, tools, glues, papers, and cards, were made available to participants, empowering them to bring their concepts to life through tangible prototypes made to be tested.

Refreshments and snacks were provided to sustain participants throughout the session. Canvases for four exercises were provided to each group, each containing explicit instructions for the respective activities. while flyers publicizing the workshop and Revigrés merchandise were distributed as tokens of appreciation. The workshop staff, comprising the facilitator, photographers, and videographers, ensured the smooth execution of activities and captured key moments for documentation and analysis.

4.4. Workshop 4.0 Core Activities: Validation Through Prototyping

With an emphasis on refining concepts based on user feedback and market potential, the workshop served as a platform for collaboration and dialogue among participants. This section will delve into the core activities of Workshop 4.0.
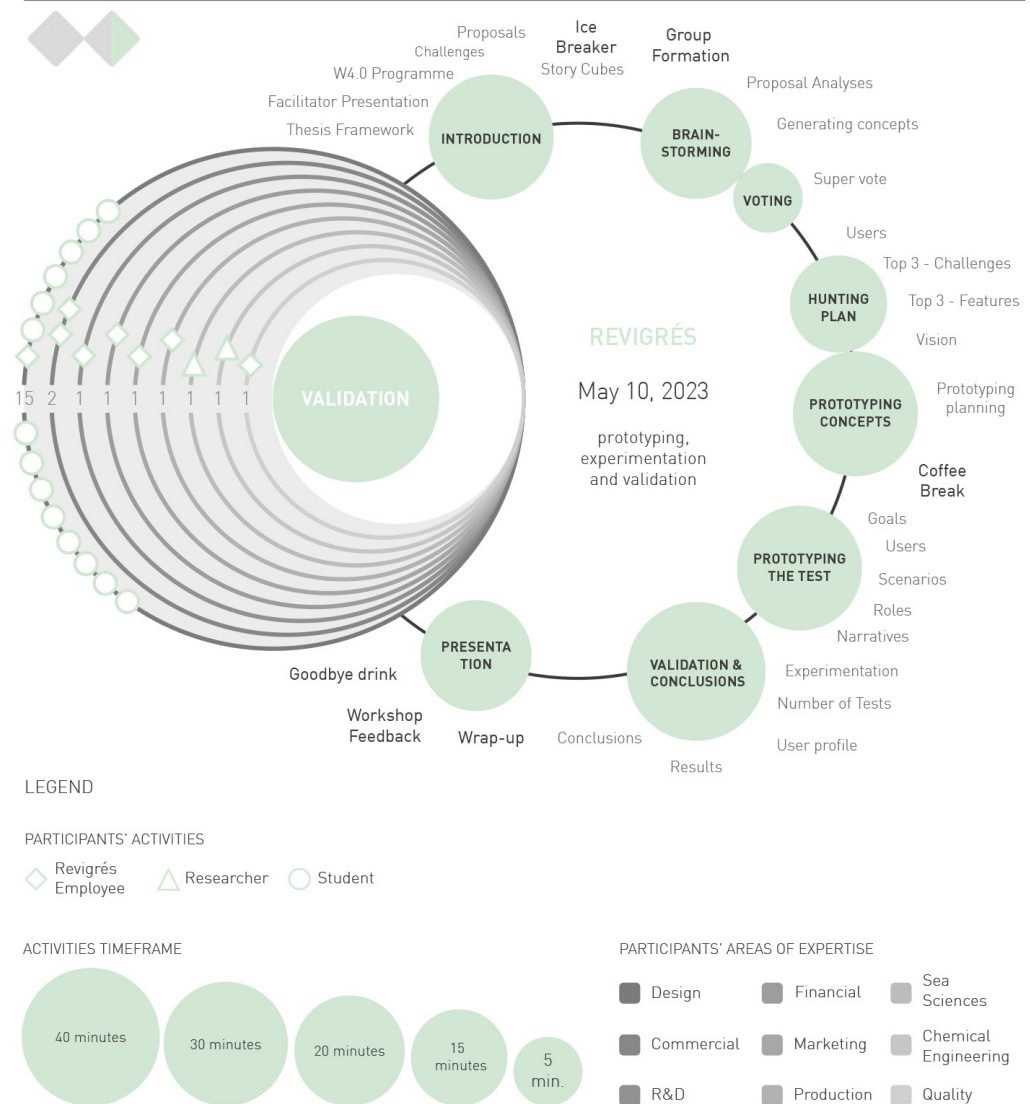
Following an initial brainstorming session where participants analyzed the challenges posed in the Co-design sessions and the proposals generated in preceding workshops, the Hunting Plan and Prototyping Concepts activities were introduced. These exercises aimed to guide participants in understanding the intricacies of their concepts and formulating targeted prototypes to test assumptions and hypotheses.

The facilitator set the stage by outlining the structural program of the workshop, elucidating the flow of activities, and the overarching goal of prototyping for validation. Participants were encouraged to delve beyond surface-level understanding and contemplate the specifics of their concepts, considering aspects such as problem identification, user relevance, and contextual application.

In previous sessions, prototypes often served as general explanations of concepts rather than focused examinations of specific functionalities. Workshop 4.0 sought to rectify this by directing attention towards the specifics of each concept. Participants were prompted to ponder questions such as: How will users experience the proposed solution? What impact will it have on their daily lives? What are the key functions of the concepts? These deliberations underscored the importance of precision in prototype development.

The Hunting Plan exercise aimed to act as a catalyst for deeper reflection, challenging participants to articulate the rationale behind their prototypes. By identifying key elements such as the target user, primary challenges, critical charac-teristics, and overarching vision, teams laid the groundwork for prototyping. This structured approach aimed to encourage teams to consider the broader implications of their concepts while homing in on specific aspects for validation.

Figure 2. Workshop 4.0 framework and methodologies (source: authors).

W4.0: FRAMEWORK & METHODOLOGIES

Structured in five stages, the Hunting Plan guided participants through a systematic planning process:
- User Identification: Teams identified the target audience for their product or service, ensuring clarity on who would benefit from the proposed solution.
- Top 3 Challenges: Participants pinpointed the primary problems or challenges that their concept aimed to address, prioritizing areas of focus for prototype testing.
- Top 3 Characteristics: Teams outlined the three most critical characteristics of their concept to be tested, laying the foundation for prototype evaluation.
- Vision Definition: A succinct vision statement was crafted to encapsulate the essence of the product or service, providing a guiding framework for prototype development.
- Prototype Planning: Building upon the identified features, teams devised concrete plans for prototyping, distributing tasks among team members, and establishing a blueprint for execution.

With the Hunting Plan set in motion, participants transitioned to the Prototyping Concepts activity, where they had the opportunity to give form to their concepts. Armed with a diverse array of prototyping materials and fueled by their creativity, teams embarked on the pivotal phase of prototype construction. The overarching goal was to challenge assumptions and test critical components of their concepts, paving the way for iterative refinement and validation.

It is relevant to mention that within the scope of this study, prototyping is not merely viewed as a means of conveying ideas but as a dynamic process of inquiry and experimentation. For this reason, participants were encouraged to explore various prototype forms, from critical experience prototypes to functional system prototypes, each serving as a lens through which to examine different facets of their concepts. This conceptual prototyping approach was meant to facilitate deep engagement with the design process, allowing teams to uncover insights and iterate towards more robust solutions.
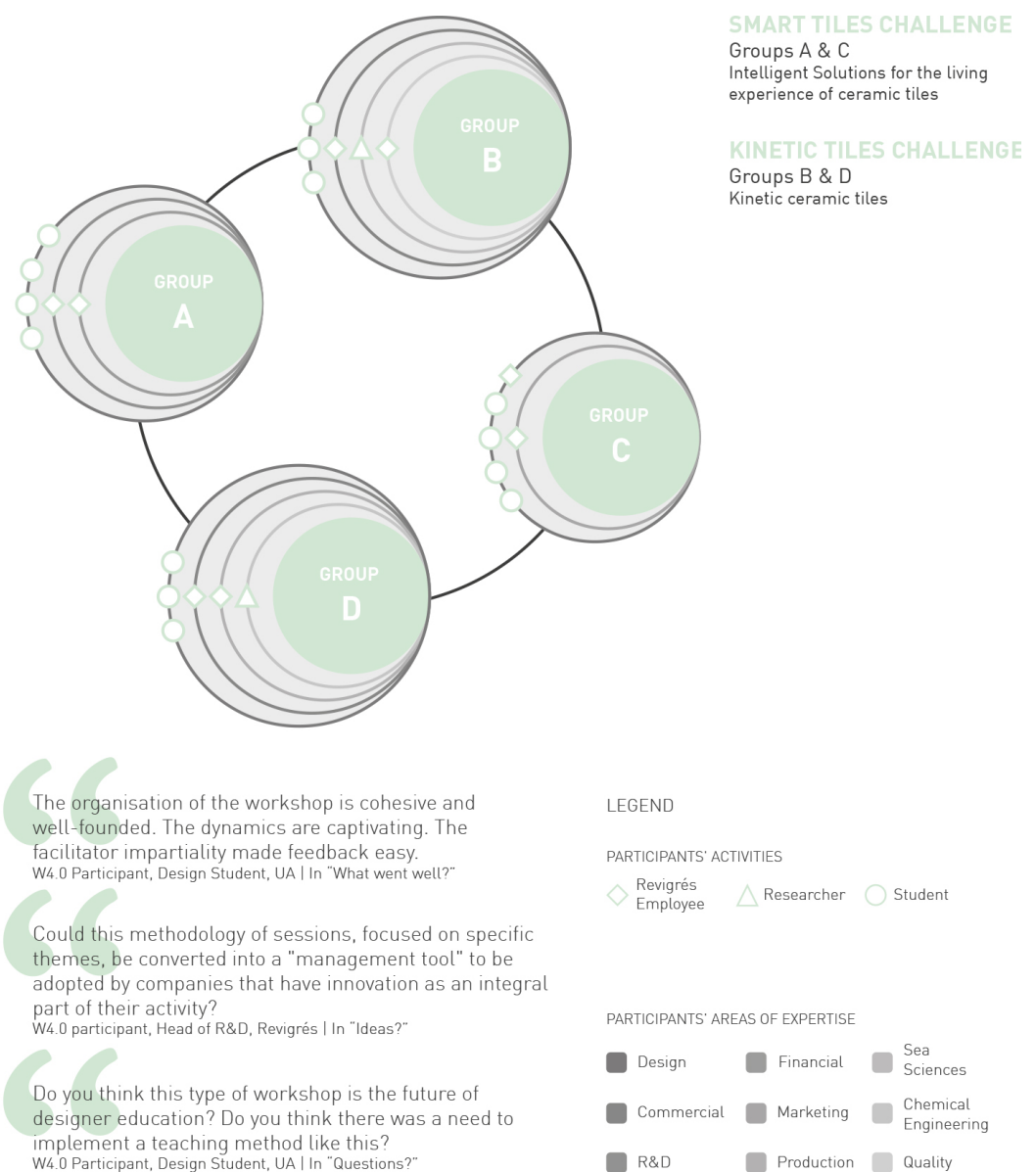
As Workshop 4.0 progressed, participants prepared for the next phase: Prototyping the Test and Validation and Conclusions activities. With the prototypes primed for user feedback, the atmosphere buzzed with anticipation as volunteers prepared to enter the workshop space.

In anticipation of the prototype testing, an activity focused on experience planning was launched. Participants were urged to craft a structured framework for the testing phase, ensuring that objectives were clearly defined and aligned with the goals of the experiment. Emphasis was placed on understanding the diverse backgrounds of the test users, who, while Revigrés employees, also represented a cross-section of potential end-users. By delineating scenarios and assigning roles to team members, participants fostered alignment and clarity in their approach to prototype testing. The delineation of objectives, users, and scenarios was incentivized and teams considered the roles each member would play during the experiment, ensuring that responsibilities were distributed effectively to facilitate a seamless testing process. The design of the testing experience was a collaborative endeavor within teams, with participants mapping out each stage to form a cohesive vision of the user journey.

Figure 3. Workshop 4.0 group structure and participants' feedback (source: authors).

W4.0: GROUPS & THEMES

SMART TILES CHALLENGE
Groups A & C
Intelligent Solutions for the living experience of ceramic tiles

KINETIC TILES CHALLENGE
Groups B & D
Kinetic ceramic tiles

“The organisation of the workshop is cohesive and well-founded. The dynamics are captivating. The facilitator impartiality made feedback easy.
W4.0 Participant, Design Student, UA | In "What went well?"

“Could this methodology of sessions, focused on specific themes, be converted into a "management tool" to be adopted by companies that have innovation as an integral part of their activity?
W4.0 participant, Head of R&D, Revigrés | In "Ideas?"

“Do you think this type of workshop is the future of designer education? Do you think there was a need to implement a teaching method like this?
W4.0 Participant, Design Student, UA | In "Questions?"

LEGEND

PARTICIPANTS' ACTIVITIES

◇ Revigrés Employee   △ Researcher   ○ Student

PARTICIPANTS' AREAS OF EXPERTISE

■ Design   ■ Financial   ■ Sea Sciences
■ Commercial   ■ Marketing   ■ Chemical Engineering
■ R&D   ■ Production   ■ Quality

Key questions guided participants in shaping the testing experience, prompting reflection on the test location, criteria for success, and sequence of activities. By capturing user feedback through documentation, including photos, videos, and canvas recordings, participants gleaned insights that would inform subsequent iterations of their prototypes and concepts. Observing users keenly during the test, participants solicited feedback and documented observations, laying the groundwork for informed decision-making in concept refinement.

Transitioning to the "Validation and Conclusions" exercise, participants meticulously cataloged the outcomes of the prototype testing. They recorded the number of tests conducted, identified user profiles, and documented interview results. Drawing from these records, participants synthesized their findings into actionable conclusions, identifying strengths, weaknesses, and areas for improvement in their prototypes.

Throughout these activities, a spirit of collaboration and inquiry permeated the workshop space, as participants engaged in iterative cycles of testing, reflection, and refinement. By embracing a user-centered approach and leveraging diverse perspectives, participants navigated the complexities of prototype validation with clarity and purpose.

As the workshop drew to a close, participants emerged with a deeper understanding of their prototypes' potential, and a presentation moment happened.

5. Insights Gained from Workshop 4.0

Workshop 4.0 served as a pivotal moment in the iterative design process, focusing on validating and optimizing proto-types developed in preceding sessions. Through a comprehensive program comprising 14 activities, participants engaged in collaborative efforts to refine product and service concepts and gather user feedback for iterative refinement.

Here are the key insights gained from Workshop 4.0:

- **Strategic Experimentation and validation:**
  One of the key insights gained in Workshop 4.0 was the importance of embracing a mindset of experimentation and constant prototyping. Participants learned that prototyping is not just about creating something tangible but about testing specific functions and mechanisms of a solution. By planning and conducting iterative experiments, participants were able to refine their ideas, concepts, and assumptions, ultimately leading to the validation of novel and effective solutions. Also, in Workshop 4.0, it became evident that user feedback and validation are integral to the design process. he direct interaction with real users during prototype testing underscored the imperative of user feedback in refining prototypes and enhancing their viability and effectiveness.

- **Facilitator's Guiding Role:**
  Central to Workshop 4.0 was the facilitator's pivotal role in instilling an ethos of experimentation and prototyping among participants. The facilitator's task encompassed aligning these endeavors with the needs, challenges, and aspirations of users, the company, and stakeholders. Balancing creativity, experimentation, and commercial viability posed a challenge, necessitating the facilitator's guidance and mentorship to ensure the workshop's success. The facilitator's efforts were instrumental in incentivizing prototyping as a means of validating assumptions, functions, and ideas in alignment with stakeholder expectations.

- **Company Innovation Gains:**
  The workshop provided valuable insights for the company, signaling a shift towards an innovation-driven and user-centric approach. By fostering a culture of experimentation and prototyping, the company could unlock new opportunities for sustainable growth and differentiation in the market. Additionally, the strategic insights gained from the workshop informed strategic decision-making processes, product development strategies, and customer engagement initiatives, positioning the company as a leader in sustainability and innovation within the ceramics industry.

- **Sustainability Focus:**
  Participants recognized the imperative of addressing sustainability challenges in energy and environmental conservation. Their proposals underscored innovative solutions integrating renewable energy sources and promoting energy efficiency and environmental stewardship.
  By translating these ideas into tangible solutions, participants contributed to a more sustainable future, aligning with the company's commitment to environmental responsibility. Each group tackled the challenge of sustainability in a unique way, showcasing the multifaceted nature of addressing environmental concerns. Group A focused on humidity control through innovative ceramic tiles, Group B explored kinetic tiles for self-sustaining environments, Group C aimed at reusing energy generation from industrial processes, and Group D worked on wind-generated electrical energy tiles.

- **Participant Learning Journey:**
  Workshop 4.0 facilitated a learning experience for participants, enabling the application of design thinking principles in real-world scenarios. Hands-on activities and collaboration with industry professionals cultivated essential skills in problem-solving, collaboration, and user-centered design. The workshop provided invaluable insights into the complexities of addressing real-world challenges and highlighted the importance of interdisciplinary collaboration in devising comprehensive solutions.

For design students, Workshop 4.0 represented an opportunity to gain practical experience alongside industry professionals. Exposure to real-world challenges, interdisciplinary collaboration, and user-centered design principles fostered essential skills necessary for their future careers. The workshop's inclusive environment encouraged cross-functional collaboration, fostering the exchange of ideas between students and employees from various departments. This collaboration

ensured a holistic approach to problem-solving, leveraging diverse expertise to develop comprehensive solutions aligned with industry standards.

The participation of Revigrés employees, spanning different departments, contributed invaluable expertise and real-world insights. Their industry experience grounded proposals in practical considerations and feasibility, enriching the workshop's outcomes. The collaborative dynamics facilitated by the workshop facilitated the exchange of ideas and perspectives between students and employees. While students brought fresh perspectives and creativity, employees' knowledge and experience ensured proposals were technically sound and aligned with industry standards.

6. Discussion

Workshop 4.0 marked the culmination of a series of co-design sessions at Revigrés, offering valuable insights into the importance of fostering a culture of design and validating user needs and company objectives for the development of the design process.

This session emphasized the significance of strategic experimentation and validation in the design process. By engaging in iterative prototyping and user testing, participants gained firsthand experience in refining product concepts based on real-world feedback. This approach not only validated assumptions but also ensured that design solutions were aligned with user needs and company objectives. The workshop demonstrated that incorporating user feedback early and often leads to more innovative and market-responsive products, ultimately enhancing Revigrés' competitiveness and customer satisfaction.

The facilitator played a crucial role in guiding participants through the design process, aligning their efforts with the strategic goals of Revigrés. By providing mentorship and direction, the facilitator ensured that participants remained focused on addressing user needs and achieving business objectives. This highlights the importance of strong leadership in driving design-led innovation within organizations. Moving forward, Revigrés can leverage the facilitator's insights and methodologies to instill a culture of design thinking across its teams, fostering creativity, collaboration, and user-centricity in all aspects of the business.

Workshop 4.0 yielded significant innovation gains for Revigrés, providing four different innovative concepts for the company. By embracing a culture of experimentation and prototyping, Revigrés can unlock new opportunities for growth and differentiation in the market. The strategic insights gained from the workshop informed decision-making processes, product development strategies, and customer engagement initiatives, driving sustainable business outcomes. Revigrés' commitment to environmental responsibility and user-centric design is not only commendable but also essential for long-term success in an increasingly competitive market landscape.

Finally, Workshop 4.0 not only advanced product development efforts but also fostered a culture of design within Revigrés. By involving employees from diverse departments and backgrounds, the workshop promoted cross-functional collaboration and knowledge sharing, breaking down silos and fostering a spirit of innovation across the organization. Moving forward, Revigrés can build upon the success of Workshop 4.0 to institutionalize design thinking principles and practices company-wide. This entails investing in design leadership, employee training and development, establishing design-centric processes and workflows, and creating platforms for ongoing collaboration and ideation. By embedding design thinking into its organizational DNA, Revigrés can sustain its competitive edge and drive continuous innovation in the years to come.

In conclusion, Workshop 4.0 served as a catalyst for experimentation and a roadmap for future development at Revigrés, highlighting the importance of a culture of design and the need for user needs and company objectives validation in the design process.

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