SYSTEMIC DESIGN AS AN EPISTEMIC AGENT: CONTRIBUTING TO APPLIED RESEARCH

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THIS ARTICLE EXAMINES HOW SYSTEMIC DESIGN CAN BE INTEGRATED INTO APPLIED SCIENTIFIC RESEARCH TO PRODUCE SITUATED, ACTIONABLE KNOWLEDGE BEYOND ITS TRADITIONAL ROLE OF MATERIALIZING OR COMMUNICATING FINDINGS. WE DRAW ON A CASE STUDY DEVELOPED THROUGH AN UNDERGRADUATE THESIS CONDUCTED AT THE ENVIRONMENTAL OBSERVATORY OF MINING PROJECTS (OA)—A PROJECT FUNDED BY THE NATIONAL AGENCY FOR RESEARCH AND DEVELOPMENT THROUGH FONDEF IDEA (ID20I10084) AND ITS SUBSEQUENT TECHNOLOGICAL RESEARCH PHASE (IT23I0066). THE THESIS RESULTED IN A SUPPORT SERVICE DESIGNED TO FACILITATE ACCESS, UNDERSTANDING, AND USE OF PUBLIC ENVIRONMENTAL INFORMATION. DRAWING ON A SUBSEQUENT ANALYSIS FRAMED BY RESEARCH THROUGH DESIGN (RTD), THIS STUDY EXPLORES HOW THE INTEGRATION OF SYSTEMS-ORIENTED DESIGN (SOD) AND THE UC PUBLIC INNOVATION LABORATORY'S TRIPLE DIAMOND FRAMEWORK SHAPED AN ITERATIVE PROCESS OF OBSERVATION, MODELING, CO-DESIGN, PROTOTYPING, AND VALIDATION. METHODOLOGICALLY, WE USED GIGAMAPS, CUSTOMER JOURNEY MAPS, SERVICE BLUEPRINTS, AND PROTOTYPES REFRAMED FROM A SYSTEMS PERSPECTIVE TO REPRESENT ACTOR NETWORKS, INFORMATION FLOWS, INSTITUTIONAL DEPENDENCIES, TEMPORALITIES, AND CONDITIONS OF ACCESS AND USE. THE FINDINGS COMBINE A SPECIFIC SERVICE AND TOUCHPOINTS WITH STRUCTURAL INSIGHTS INTO CAPACITY ASYMMETRIES, FRAGMENTATION OF SOURCES, TRACEABILITY GAPS, AND TEMPORAL MISMATCHES IN PARTICIPATION PROCESSES. THE CASE SUGGESTS THAT DESIGN ARTIFACTS CAN GENERATE PROCESS EVIDENCE AND CONTRIBUTE TO FORMULATING AND TESTING SITUATED HYPOTHESES.

KEYWORDS: SYSTEMS-ORIENTED DESIGN, SYSTEMIC DESIGN, RESEARCH THROUGH DESIGN, APPLIED SCIENTIFIC RESEARCH, KNOWLEDGE PRODUCTION

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1. INTRODUCTION

In recent decades, design has expanded beyond its traditional boundaries to encompass scientific and interdisciplinary projects with high levels of sociotechnical complexity. In these contexts, its role is not limited to materializing or communicating results; it can also contribute to shaping shared frameworks of understanding and generating insights through the design process itself. This expansion has required the discipline to develop conceptual and methodological frameworks that demonstrate its contribution to scientific and interdisciplinary projects—especially those where innovation and sustainability depend as much on generating actionable knowledge as on its contextual relevance and user adoption. In these settings, design has been integrated with applied research approaches such as Research through Design (RtD), where knowledge emerges from artifacts and from reflection on the design process itself (Frayling, 1994; Findeli & Coste, 2007; Cross, 1999; Mollenhauer et al., 2020; Mollenhauer et al., 2023b).

In applied research contexts involving multidisciplinary teams, design can contribute both to delivering results and to framing shared understanding—articulating languages, criteria, and working methods across disciplines. Cases from Chile suggest that this methodological coordination role helps align teams and translate findings into development decisions in complex scenarios (Culagovski & Del Río, 2022).

This article contributes to that disciplinary discussion by reflecting on the role of systemic design within an applied scientific research project conducted by the Environmental Observatory of Mining Projects (OA). Funded by the National Agency for Research and Development (ANID) through FONDEF grants ID20I10084 and IT23I0066, the project aimed to strengthen transparency, access to, and understanding of public environmental information by integrating sources, co-developing indicators, and building an open-access platform (Bergamini et al., 2023; 2025).

In this context, the article analyzes an undergraduate design thesis developed within the OA framework. The thesis aimed to design a support service facilitating access to, understanding of, and use of the platform's public environmental information, while also promoting learning and citizen participation in mining project evaluation. The project won the 2024 Chile Design Award in the Service Design academic category—a recognition of its professional and academic merit, though not, in itself, a scientific validation of the results presented here.

Beyond its tangible outcomes, the subsequent process review allowed us to examine whether the systemic design tools had contributed to generating knowledge about the environmental management system and the relationships that shape it. This question motivated the reflection we present here and builds on the team's previous work on the OA, community capacity building around environmental information, and the support service development (Mollenhauer et al., 2023a; Rodríguez et al., 2025). Drawing on a critical review conducted after the project, we argue that adopting the SOD methodology not only structured the design approach but also influenced how the scientific research understood its context, identified gaps, and represented the complexity of its object of study.

The proposal developed in the thesis did not remain confined to academia. Its findings, intervention criteria, and the definition of the support service provided one of the conceptual and methodological foundations for the subsequent technological research phase of the OA (IT23I0066). In this phase, the support service was revisited and adapted as a development line to strengthen platform adoption by creating resources and services designed to support understanding, navigation, and use of public environmental information.

The undergraduate thesis serves as the central artifact of this study—encompassing its process, records, and outcomes—while this article offers an analytical re-reading that clarifies what knowledge was produced, how it was tested during the process, and what its limitations are.

Based on this review, the article addresses the following question: How can the application of systemic design methodologies in service design projects be integrated into applied scientific research to generate knowledge, materialize tangible solutions, and systematize transferable learning? The objective is to demonstrate how SOD provided a methodological framework that allowed us to integrate design-specific processes—observation, modeling, and comparison—with the project's scientific goals, contributing to an understanding of the environmental system and producing traceable, evaluable lessons learned.

2. THEORETICAL FRAMEWORK

2.1. RESEARCH THROUGH DESIGN

The RtD approach describes a type of research in which knowledge emerges from the design process. Within this framework, artifacts, services, or systems act as vehicles for exploration, experimentation, and empirical testing. Frayling (1994) distinguishes three modes of design research: research on, for, and through design. The latter recognizes the project as a space where making and reflecting converge.

Findeli and Coste (2007) argue that RtD is embedded in a specific context and aims to transform it, combining methodological rigor with abductive reasoning. For knowledge generated through the design process to be communicable and evaluable, explicit procedures for data collection, recording, and analysis are needed. The importance of systematicity has also been addressed in methodological manuals for designers and in guides that emphasize the need to validate proposals in their contexts of application (Muratovski, 2016; Montalván Lume et al., 2019).

In this view, prototypes function as learning tools. They allow us to explore ideas and configurations and communicate findings at different stages of the process (Coughlan et al., 2007). Thus, design not only materializes solutions but can also generate knowledge about the intervention context and the design decisions themselves.

2.2. SYSTEMIC DESIGN AS AN EPISTEMIC AGENT

Recognizing systemic design as an epistemic agent means acknowledging that its practice not only draws on knowledge from other disciplines but can also generate its own. Cross (1999) defined design as a third way of knowing—alongside the sciences and humanities—characterized by synthesis, modeling, and the exploration of possible solutions.

From a systemic standpoint, design knowledge extends beyond the designed artifacts or outcomes to encompass the relationships, interdependencies, and tensions that the process brings to light. Representation and intervention can thus serve as complementary means for understanding and reconfiguring a situation.

Glanville (2024) argues that design and scientific research are intertwined in a hybrid field where their methodological differences can be complementary. From this standpoint, systemic design can be understood as a cognitive practice that integrates understanding, projecting, and testing. However, its epistemic value depends on making the procedures, decisions, and limitations of the process explicit and assessable.

In Chile and Latin America, this discussion is part of a critical tradition that explores design's relationship to development, institutional frameworks, and technology transfer. Gui Bonsiepe's work brought design into dialogue with public policy, productive capacity, and the social project (Palmarola, 2001). The systemic approach can thus be read as a contemporary operationalization of that situated orientation.

2.3. SOD AS A METHODOLOGICAL FRAMEWORK

Within academia, the relationship between design and complex systems has been discussed, including its contributions and limitations for design practice and education (Chávez López, 2021). Along these lines, SOD—developed by Sevaldson—integrates systems thinking and design practice to address highly complex problems where multiple actors, timeframes, and levels converge (Sevaldson, 2022). Unlike user-centered design thinking, SOD positions the designer as a systems orchestrator, capable of understanding and reconfiguring networks of relationships, information flows, and institutional structures (Sevaldson, 2022).

SOD's methodology uses tools such as gigamapping and visual thinking to represent and explore the complexity of systems, their relationships, and interdependencies (Sevaldson, 2015). Rather than simplifying reality, SOD seeks to make it intelligible and transformable, using representation and prototyping as mechanisms for observation and learning.

However, applying RtD and SOD in highly complex contexts raises challenges regarding rigor and legitimacy. Modeling artifacts—such as gigamaps and service blueprints—are not neutral; they are shaped by framing decisions. Their epistemic value therefore hinges on explicit mechanisms to ensure traceability, enable intersubjective review, and delineate the scope of generalization.

2.4. INTEGRATION OF METHODOLOGICAL FRAMEWORKS AND DISCIPLINARY CONSOLIDATION OF DESIGN

The intersection of RtD and SOD offers a framework for examining design's contribution to applied scientific research. Together, these approaches allow us to explore how knowledge emerges from design practice, situates itself within systemic relationships, and is operationalized through instruments for observation, modeling, and cross-checking.

Mollenhauer et al. (2023b) argue that systematizing and abstracting design thinking allows us to connect case studies from practice to processes of theoretical construction. From this perspective, design can move beyond a purely instrumental role to contribute to producing process evidence, building interpretive frameworks, and generating actionable knowledge in interdisciplinary research.

3. METHODOLOGY

The thesis methodology integrated two complementary approaches: SOD and the Triple Diamond model developed by the Public Innovation Laboratory at the Pontificia Universidad Católica de Chile (2017). This integration enabled a service design methodology tailored to the project's applied and interdisciplinary nature. While it guided the development of a tangible outcome—the OA support service—it also provided a framework for observing, modeling, and comparing relationships, needs, and implementation conditions within a complex system. Overall, the methodology aimed to produce situated knowledge and incorporate explicit validation mechanisms throughout the project.

The process was iterative, collaborative, and reflective. Each stage was designed as an opportunity for data collection, interpretation, and learning, with findings informing subsequent decisions. Rather than following a strictly linear sequence, the project unfolded through successive cycles of understanding, formulating, prototyping, comparison, and systematizing. This dynamic enabled the thesis findings to be linked to the broader scientific research objectives and allowed us to document how specific evidence shaped the reformulation of assumptions, intervention criteria, and service components.

Data collection relied on a qualitative, multi-method, iterative strategy that combined remote and in-person sessions. The thesis process included two internal gigamapping sessions with OA researchers; three individual interview-workshops and one group needs assessment workshop with citizens and local stakeholders; a day of field data collection with 19 residents of San José de Maipo; four co-design sessions organized by stakeholder type; four service validation sessions; one expert content validation session; and one in-person session to validate the service's touchpoints with seven citizens. Since some participants took part in more than one stage, the figures reported correspond to participation per activity rather than to unique individuals.

Participants were selected through purposive and snowball sampling designed to include a range of roles, levels of expertise, and experiences related to environmental management. For this purpose, we drew on the OA's contact database, along with representatives from partner institutions, local organizations, and potential service users. This strategy was complemented by including passersby during field activities to broaden the diversity of perspectives and ensure the study was not limited to stakeholders already familiar with the topic or the project. Remote exploration and co-design sessions lasted approximately 40 to 60 minutes; service validation sessions, 30 to 40 minutes; and brief in-person interactions, 10 to 20 minutes.

The corpus analyzed consisted of audio recordings, field notes, photographic records, transcripts, worksheets, and physical and digital sticky notes. All activities were conducted with prior informed consent. Records were used solely for academic purposes, and participants' identities were protected in the reporting of results, unless they expressly authorized identification. The information was systematized through a visual and systemic analysis procedure grounded in visual thinking and sensemaking.

In the first stage, records were transcribed and digitized. The data were then organized by journey stage, stakeholder type, and mode of participation. From there, the data were grouped by affinity to identify recurring themes, divergences, needs, barriers, and intervention opportunities.

Findings from interviews, workshops, and field activities were cross-checked and consolidated into visual matrices that linked empirical evidence to design decisions. This process informed the iterative refinement of gigamaps, customer journey maps, service blueprints, prototypes, and touchpoints. Validation was conducted through intersubjective review involving OA expert researchers, representatives from partner institutions, and potential service users to examine the consistency of representations, the relevance of findings, and the feasibility of proposals. The process thus aimed to maintain a traceable chain from data collection, systematization, interpretation, design decisions, and iteration, without equating validation with long-term impact assessment.

As summarized in Figure 1, the process integrated the stages of the Triple Diamond with the principles of SOD. This integration linked the exploration, definition, ideation, development, refinement, and piloting phases with activities such as framing, listening, modeling, building scenarios, and identifying intervention opportunities. The figure does not represent a strictly linear sequence but rather an iterative structure in which partial results informed subsequent stages.

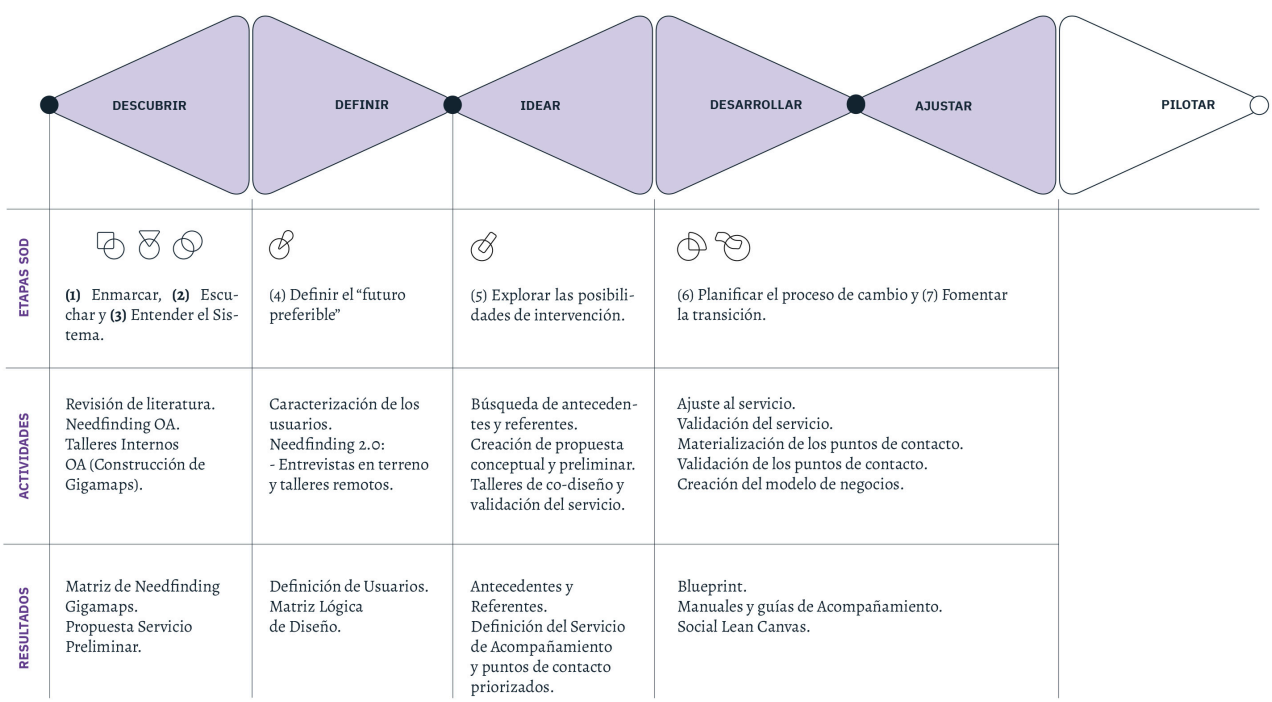


FIGURE 1. Methodological integration between the Triple Diamond and the SOD. Source: Rodríguez (2023), based on the UC Public Innovation Lab (2017) and the Systemic Design Toolkit (n.d.).

3.1. INTEGRATING SYSTEMIC DESIGN INTO APPLIED RESEARCH

The thesis project was not structured as a separate phase following the OA's research and development process, but rather as an integrated, cross-cutting component from the outset. Throughout, it was developed in consultation with the research team, environmental management professionals, public and private sector stakeholders, and civil society representatives—forming a process centered on problem definition, hypothesis formulation, and iterative comparison.

The integration of systemic design into the scientific process was based on a co-design dynamic, in which design practice and disciplinary research continuously informed one another. Systemic design provided observation and modeling methods that complemented environmental management research's analytical approaches, generating learning that helped redefine objectives, prioritize variables, and better understand user needs. In turn, scientific findings—environmental data, legislative frameworks, and information flows across public platforms—shaped design decisions, resulting in an interdisciplinary research process.

3.2. SOD AS A STRUCTURAL FRAMEWORK

SOD served as the primary framework for organizing the methodological process. Grounded in systems theory and design thinking, SOD enabled the OA project to be addressed as a highly complex problem involving multiple actors, institutional layers, and temporal dimensions.

In Latin American academic discourse, there has been growing recognition of the need to move beyond reductionist approaches toward systemic thinking to address complex problems, emphasizing its connection to interdisciplinary work and skills such as managing uncertainty and nonlinear reasoning (Cárdenas et al., 2010).

The process began by creating gigamaps, a tool that offered an integrated view of the system's components—public agencies, companies, communities, regulatory frameworks, and information flows. This systemic map served not only as a diagnostic tool but also as a platform for sharing knowledge. By visualizing the entire system, the OA team could identify critical points, redundancies, gaps, and opportunities for intervention. The graphical representation provided a shared language among the technical, scientific, and design teams, turning the visualization into a space for collective reflection.

To prevent gigamapping from becoming a purely descriptive exercise, the modeling was structured around a set of explicit variables defined and iteratively refined with the OA team. These variables functioned as both "layers" of the map and analytical criteria for identifying tensions and opportunities for intervention:

1. Actors and Roles: public agencies, government entities, private companies, consulting firms, communities, and civil society organizations.
2. Artifacts and sources of information: records, decisions, reports, databases, and public platforms; standardization and traceability levels across sources.
3. Flows and Breakpoints: environmental inputs and outputs, duplications, gaps, bottlenecks, and institutional dependencies (backstage).
4. Seasonality: key stages of the environmental assessment and management cycle and their relationship to public participation opportunities; time lags between information availability and decision-making.
5. Terms of Access and Use: technological barriers, comprehension barriers (technical language), navigation barriers, and capacity barriers (time/skills).

These dimensions guided both the creation of the gigamaps and their translation into interaction maps (customer journey maps/service blueprints) and service prototypes, enabling us to link design decisions to evidence observed within the system.

The iterative construction of the gigamaps aimed to represent the main components and relationships of the environmental management system. The maps considered stakeholders, institutions, information sources, flows, timeframes, access conditions, and breakpoints. As shown in Figure 2, early versions focused on identifying components and activities, while later versions incorporated relationships, flows, and structural tensions. This progression allowed us to compare the initial representation with the OA team's expert knowledge and move from a description of the system toward a shared visual hypothesis regarding its interdependencies.

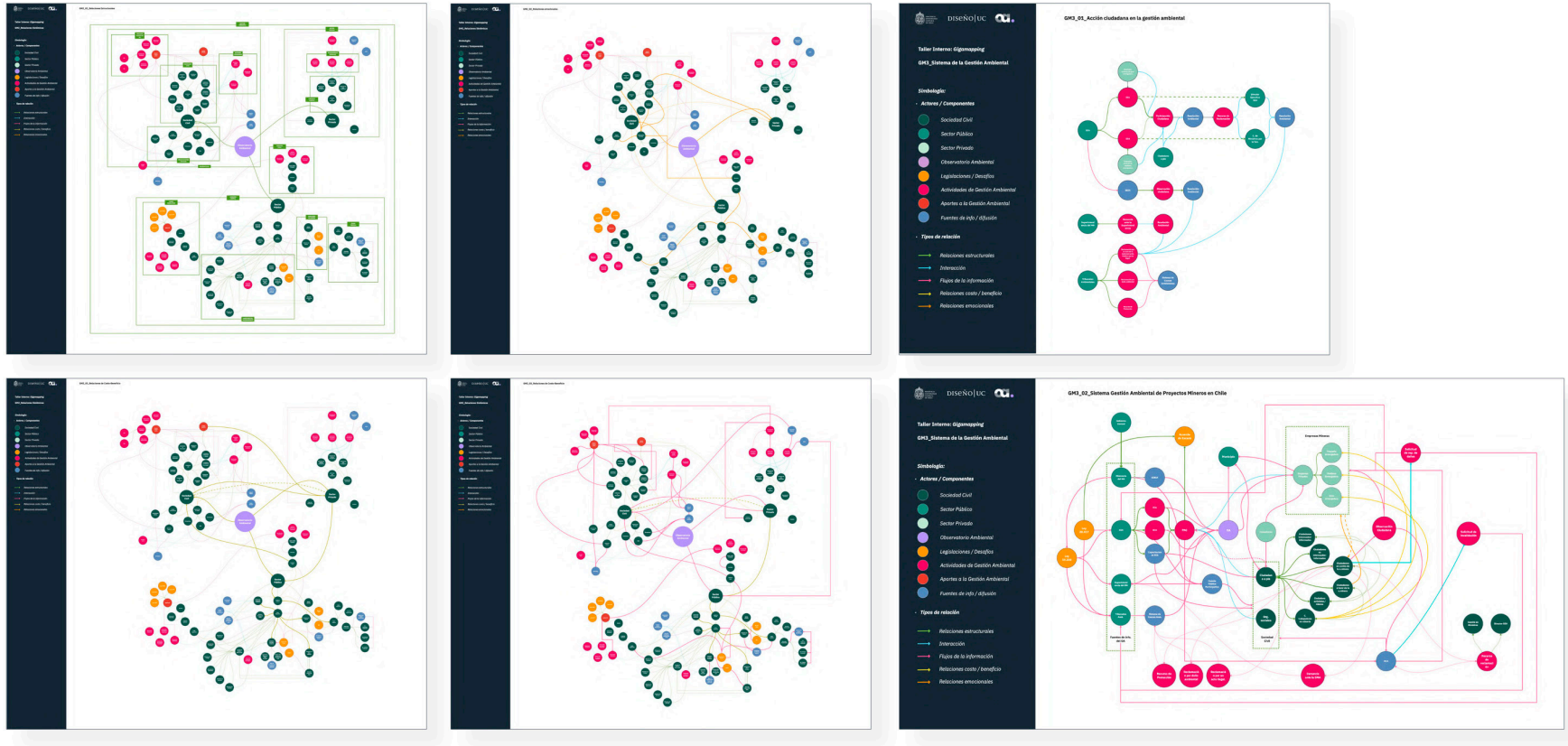


FIGURE 2. Iterations of the gigamap of the environmental management and information system. Source: Rodríguez, J. (2023).

SOD's systemic approach informed service design beyond the design of specific objects or interfaces, incorporating the articulation of relationships, dependencies, and institutional conditions. Across iterations—from conceptual modeling to functional prototypes—the focus was on understanding how people interact with information, how environmental data flows, and how platforms can support continuous learning and decision-making.

In this context, customer journey maps and service blueprints were developed as diagnostic tools and as a means of bringing the solution to life. However, unlike their traditional use—which focuses on a specific user's sequence of actions and their interaction with a service—these artifacts were constructed from a systemic perspective. This allowed us to visualize the relationships among stakeholders, institutional dependencies, and the mutual influences at play within the environmental management system.

Drawing on the findings from the gigamapping exercise, we developed a customer journey map that organized the experience of reviewing and using environmental information according to the before, during, and after stages. As shown in Figure 3, the tool incorporated barriers, support needs, stakeholders, and opportunities for intervention. In doing so, the map not only described the individual experience but also linked it to institutional, technological, and territorial conditions.

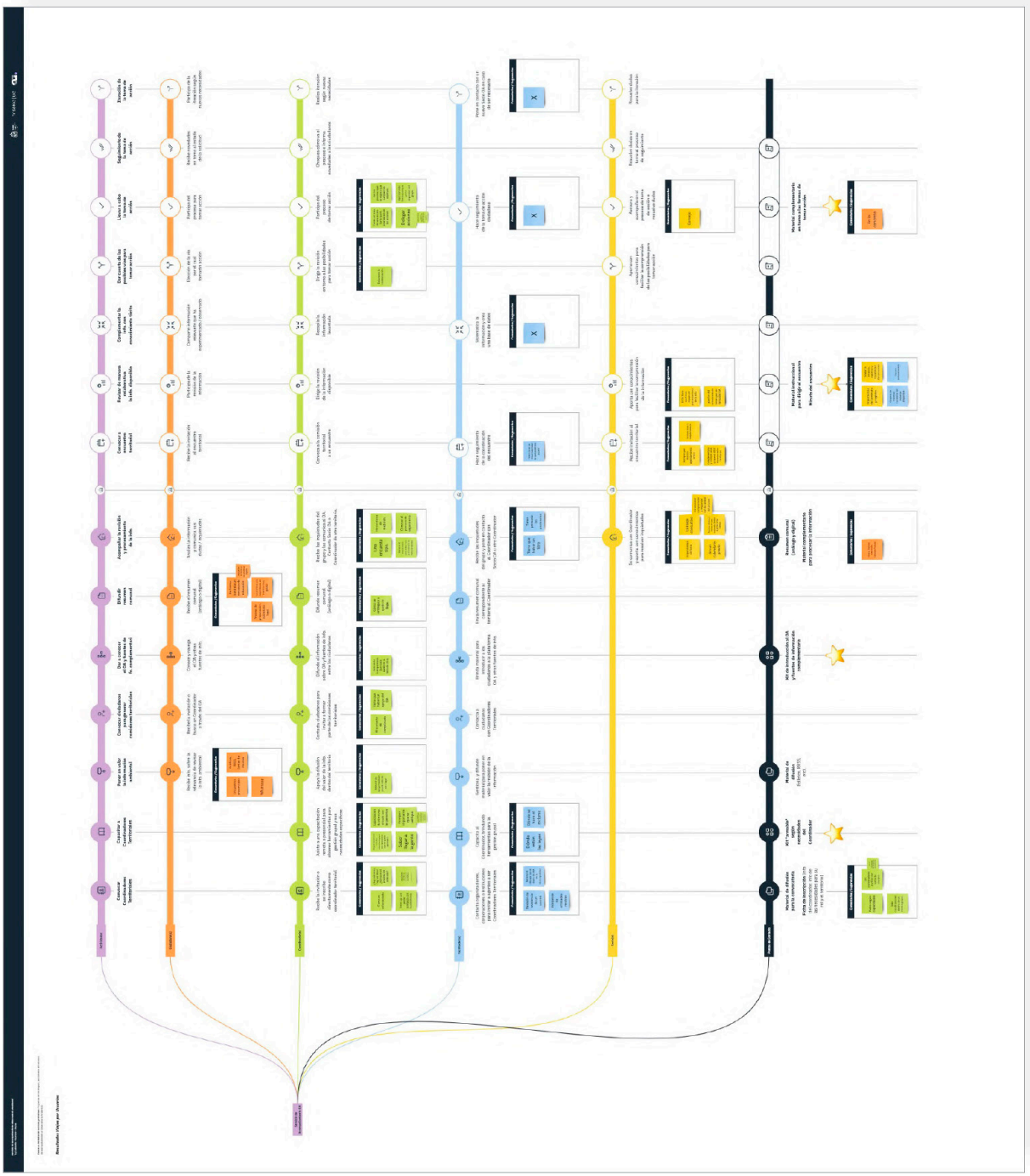


FIGURE 3. Systemic customer journey map associated with the review and use of environmental information. Fuente: Rodríguez, J. (2023).

The service blueprint enabled us to translate findings from systemic modeling into an operational service structure. As shown in Figure 4, the diagram links activities visible to citizens and regional coordinators with the internal actions performed by the OA and its partner institutions. This representation clarified the responsibilities, dependencies, and touchpoints required for service delivery.

In doing so, the tools moved beyond merely representing an individual user's experience and became systemic interaction maps that integrated multiple perspectives and revealed how each actor's decisions affect the others. This methodological reframing expanded their function: they served both to diagnose the system and to guide solution development, offering a shared interpretive framework between design and the ongoing scientific research.

3.3. THE TRIPLE DIAMOND MODEL FROM THE UC PUBLIC INNOVATION LAB

The second methodological framework was the Triple Diamond, developed by the Public Innovation Laboratory at the Pontificia Universidad Católica de Chile (2017). This model expands on the Design Council's classic Double Diamond (2019) by incorporating a third phase focused on the transfer and validation of learning—a feature that proved particularly relevant for both designing a public service (the OA support service) and conducting applied research.

Designing a public service with this approach requires strategic participation management throughout the process—defining relevant stakeholders, levels of involvement, and the timing and mechanisms for systematization and documentation—to ensure that participation is more than a procedural requirement without real impact. Design-based participation management models propose coordinating these variables to enable co-creation as an ongoing practice and generate useful evidence for decision-making (Salvatierra, 2021).

Each diamond represents a cycle of divergence and convergence. The first focuses on exploration and understanding: observing stakeholders, gathering information, and creating context maps. The second focuses on definition and development: synthesizing findings, formulating hypotheses, and designing service prototypes. The third focuses on validation and transfer: evaluating prototypes, capturing lessons learned, and outlining a plan for scaling the support service within the OA.

This model allowed us to establish mechanisms for continuous iteration, in which the results of one phase informed the next and, simultaneously, the ongoing scientific research. Each cycle generated learning that not only influenced the service's development but also helped refine the conceptual and operational frameworks of environmental research. In this way, the methodology became a reflective tool that integrated the rhythms of project-based research with those of scientific inquiry.

3.4. REDESIGNING CUSTOMER JOURNEY MAPS AND SERVICE BLUEPRINTS SYSTEMICALLY

For the OA case, customer journey maps and service blueprints were not used solely as tools focused on the "user-service provider" sequence, but rather as multi-stakeholder interaction maps. To achieve this, (1) the unit of analysis shifted from the "individual experience" to stages of coordination (information exchanges, validations, and dependencies); (2) dimensions were incorporated by actor and role (agencies with environmental jurisdiction, landowners, consulting firms, communities, and the OA); and (3) we made explicit the institutional and data "backstage" (breakpoints, duplications, gaps, and unspoken rules), allowing us to observe how environmental information is produced, circulated, and made actionable.

This reframing enabled us to critically examine frictions that cannot be reduced to "usability"—such as temporal mismatches, traceability gaps across sources, and comprehension barriers—and to link systemic modeling to design decisions for the support service, including the prioritization of touchpoints, procedures, and support criteria.

3.5. A REFLECTIVE AND ITERATIVE DESIGN PROCESS

The methodological process was iterative and reflective throughout. The design tools—gigamaps, customer journey maps, service blueprints, and prototypes—were conceived not only as deliverables but also as vehicles for research and learning. Each iteration allowed us to test hypotheses, revisit assumptions, and generate new learning about the environmental system and user experiences.

This approach established systemic design as an applied research methodology, in which each design decision was at once a creative and a cognitive act. Reflection on practice—a hallmark of the RtD approach—was embedded in the process through joint

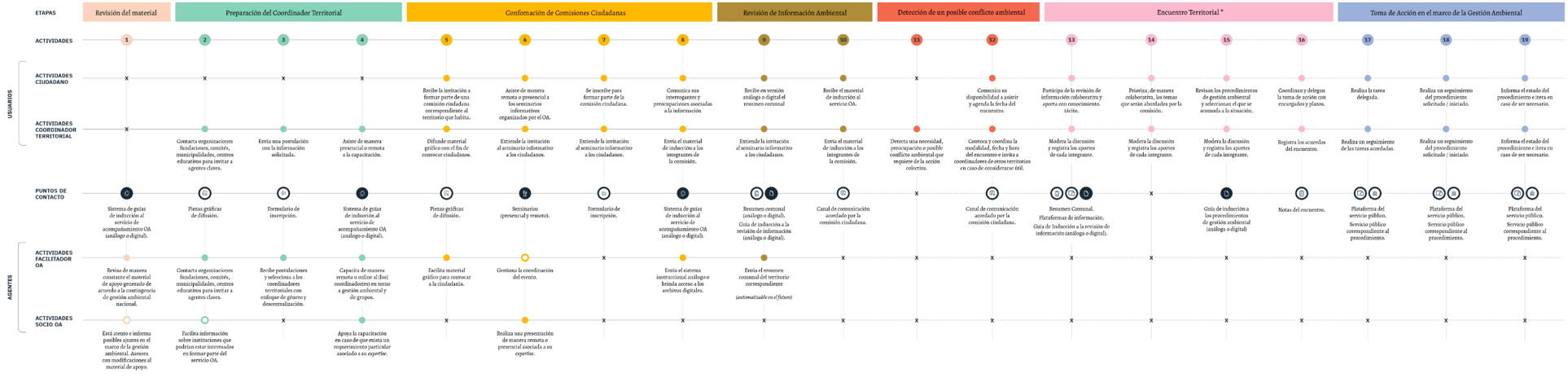


FIGURE 4. Systemic service blueprint for the OA support service.
Source: Rodríguez, J. (2023).

review sessions with the project's researchers, enabling us to trace how design decisions shaped our evolving understanding of the system, while also observing how research findings informed subsequent design iterations.

In operational terms, iteration took the form of a sequence of traceable adjustments across tools: (i) the gigamap allowed us to redefine intervention areas by revealing traceability gaps, information asymmetries, and temporal misalignments; (ii) these findings were translated into coordination flows in the customer journey maps and service blueprints; and (iii) these definitions were validated through touchpoint prototypes, leading to adjustments in support criteria and operational components to ensure sustainable service delivery. In doing so, the lessons learned resulted not only in usability improvements but also in documented shifts in assumptions, priorities, and intervention criteria, grounded in observed evidence and multi-stakeholder feedback.

TABLE 1. Methodological resources and type of evidence produced (OA case). Source: Prepared by the authors.

SYSTEMIC RESOURCE	PURPOSE	VARIABLES OR DIMENSIONS	EVIDENCE PRODUCED	QUALITY AND VALIDATION CRITERIA	RESULT
Gigamap (SOD)	Understand the system and its interdependencies; identify structural tensions.	Actors and roles, information flows, breakpoints, information sources, timeframes, and barriers to access and use.	Multi-layered visual map highlighting tensions, critical points, and areas requiring attention.	Validation by OA team experts; consistency between Gigamap versions and information layers.	Theoretical System Models; Intervention Criteria.
Customer Journey Map (Systemic)	Highlighting multi-stakeholder tensions and critical junctures in environmental information review and use.	Citizen participation channels, decision-making processes, touchpoints, and stakeholder mediation.	Multi-Actor Interaction Sequences.	Triangulation of records and workshop data; coherence and consistency with Gigamaps.	Touchpoint Prioritization, Support Criteria, and Operational Definitions.
Service Blueprint (Systemic)	Institutional frontstage and backstage, including service delivery dependencies.	Institutional Capacities, Action Levels, Transfers, and Responsibilities.	Frontstage and Backstage Interconnections Across Actors.	Feasibility review by the OA research team; responsible parties and workflows.	Operational Requirements and Support Service Design.
Prototypes and Proof of Concept for the Support Service	Comparison of Support Service Understanding, Demand, and Operation.	Language, navigation, timing, operational load, and implications.	Test Findings and Revisions.	Decision and iteration records; preliminary evidence of shifts between the initial and reformulated situations.	Support service adjustments and transferable skills.

4. RESULTS

The design process for the OA support service produced both tangible and intangible results. This section first presents the findings from the undergraduate thesis—namely, the service, artifacts, and evidence derived from gigamaps and prototypes—and then offers an analysis of these results in relation to applied scientific research. This distinction helps clarify which evidence originates from the design process and which stems from the analytical reflection developed for this manuscript.

4.1. TANGIBLE THESIS OUTCOMES: THE OA SUPPORT SERVICE

The main tangible outcome was the design of the Support Service, originally developed in the thesis and later presented by the team as a systemic design proposal to help communities access, understand, and use environmental information (Rodríguez et al., 2025). The service includes a series of components designed to support both the review of environmental information and citizen participation in environmental management processes in the Chilean context.

From the SOD perspective, the service was conceived as a relational ecosystem involving users, data, and institutions, aligned with a multilevel information delivery strategy that accounts for differences in specialization, capabilities, and uses among stakeholders (Mollenhauer et al., 2024). Accordingly, its design incorporated touchpoints and referral criteria to support learning and guidance for interpreting public environmental information, tailored to each user's needs.

The proposal also served as a precursor to the OA's subsequent Technological Research phase (IT23I0066), building on prior work by the team on strengthening community capacities through environmental information and support (Mollenhauer et al., 2023a; Rodríguez et al., 2025). In line with this, the support service was incorporated as a strategy to promote platform adoption, translating the thesis findings into guidance and support resources tailored to different user profiles. In this way, the project's outcome moved beyond its status as an academic prototype to inform an institutional line of implementation for the Observatory.

4.2. Intangible thesis outcomes: insights from systemic modeling with gigamaps

Gigamapping yielded structural insights into the system for accessing and using public environmental information. In particular, it revealed patterns that were not evident in single-user or single-touchpoint approaches:

1. Asymmetries in Capacity and Intermediation. The gigamap revealed that effective use of environmental information depends on mediating factors—technical, legal, and communicational—that are unevenly distributed among stakeholders. This asymmetry undermines understanding and, in turn, limits the capacity for informed participation.
2. Fragmentation, Redundancy, and Traceability Gaps. The gigamap revealed multiple information sources and platforms with heterogeneous organizational structures, resulting in redundancies, gaps, and discontinuities in information tracking. The review process often breaks down during handoffs between platforms, milestones, or responsible parties, making it difficult to reconstruct decisions and background information.
3. Temporal Discrepancies Between Decision-Making, Information Availability, and Participation. The modeling revealed that effective windows for public participation and the time required for review and interpretation do not always align with information availability or with the milestones of the environmental assessment or management process. This results in participation that is often reactive or delayed—stemming not from a lack of interest, but from structural conditions within the system.

These findings, which emerged from the undergraduate thesis, were not limited to diagnosis: they also shaped decisions about the support service and guided subsequent iterations of systemic tools and prototypes.

4.3. Intangible thesis outcomes: insights from prototypes and the service pilot

The touchpoint prototypes and pilot model enabled us to test assumptions about understanding, demand, and the service's operational sustainability. Three key lessons emerged:

1. Learning About Comprehension. During the pilot sessions, participants valued the support that translated technical language into concrete guidance on what information to review, in what order, and for what purpose. The value lies not in explanation alone, but in structuring a reading path and context-specific action.
2. Learning about operations. Demand for environmental information tends to cluster around key decision points and high-friction tasks such as searching, comparing, and interpreting. The data suggest that, without clear guidance or support tools, these tasks can become a burden that some users struggle to manage.
3. Learning about transferability and scalability. The validation identified responsibilities, governance mechanisms, and feedback procedures as key conditions for integrating the service into the OA.

Taken together, these insights complement the systemic modeling findings and reinforce the Service's role as an applied research artifact: a tool that generates preliminary evidence and enables refinement of assumptions through prototyping, testing, and reviewing with stakeholders.

The empirical validation reported here is based on a pilot and proof-of-concept phase. It allowed us to test assumptions about understanding, demand, and service operation, but it does not represent a long-term evaluation of systemic impact. To ensure traceability, we documented the data collection, co-design, and validation phases, along with their methodologies, participant profiles, and duration. However, these records constitute process evidence and cannot reveal sustained changes in participation, institutional decisions, or effective information use. Future phases should include a baseline, external indicators, and longitudinal follow-up.

4.4. Post-test (RTD): interpretation of the dual results

Taking the thesis as the primary artifact and its process evidence as a starting point, the subsequent analysis for this publication interpreted the support service as a dual outcome: a tangible manifestation and a tool for applied research. In doing so, systemic design tools acted as mediators in producing and testing knowledge: gigamaps functioned as visual hypotheses about the socio-technical system; service blueprints, as observable models of dependencies and coordination mechanisms (frontstage/backstage); and touchpoint prototypes, as vehicles for empirical cross-checking through iterative testing and situated feedback.

5. Discussion

5.1. Service as a systemic prototype

The project hypothesis held that a support service—coordinated with the OA platform and with local and institutional stakeholders—could reduce barriers to understanding and guide the use of public environmental information. In this view, the support service functions as a systemic prototype: a tool for exploring

relationships within a socio-technical system and for testing assumptions about how environmental information is accessed, interpreted, and used.

The service's iterations generated context-specific feedback on understanding, demand, coordination, and breakpoints. This evidence contributed both to refining the proposal and to revising the initial interpretation of the system.

This experimental role aligns with hypothesis-driven approaches to innovation. Blank (2007) argues that defining a solution requires cycles of discovery and validation, in which initial assumptions are tested and—when evidence warrants it—reformulated. Similarly, Ries (2011) frames innovation as a series of experiments designed to transform hypotheses into evidence and learning.

Applied to systemic design, this logic positions design artifacts as tools for testing hypotheses rather than as definitive solutions. Gigamaps offered visual hypotheses of the system; journey maps and service blueprints made systemic interactions and dependencies visible; and touchpoint prototypes enabled testing of assumptions with experts, partner institutions, and potential users.

In this sense, the case suggests that design can serve to formulate, test, and reformulate situated hypotheses about how complex systems function. To support this, the relationship among assumptions, evidence, decisions, and iterations must be explicit and traceable.

5.2. THE ROLE OF SYSTEMIC DESIGN IN APPLIED RESEARCH

Integrating systemic design into applied research can reshape both the role of design and the type of knowledge it generates throughout the process. Table 2 presents an analytical comparison—drawn from the OA case study and its subsequent analysis—between a predominantly instrumental role for design and one grounded in a systems approach.

TABLE 2. Analytical comparison (OA case) of design participation in applied research with and without a systemic approach. Source: Author's own work.

ANALYSIS VARIABLE	PREDOMINANTLY INSTRUMENTAL INVOLVEMENT OF DESIGN	DESIGN INVOLVEMENT FROM A SYSTEMIC PERSPECTIVE
Context perception	Context is understood as an application setting or operational environment. Design tends to act reactively in response to given conditions.	Context is understood as an interconnected system of actors, structures, and dynamics. Design contributes by interpreting and modeling relationships to understand how the system operates.
Identification of gaps and opportunities	Gaps are identified primarily from the user's or end result's perspective, prioritizing functional or communication-related problems.	Gaps are identified through systemic mapping and relational analysis, making structural tensions and dependencies between actors visible.
Complexity management	Complexity is reduced through simplification, problem segmentation, or a focus on controllable variables.	Complexity is accepted as an inherent condition of the context. Visualization, iteration, and co-creation are used to make it open to discussion, understandable, and manageable.
Design methods, techniques, and instruments	Artifacts (e.g., customer journey maps and service blueprints) are used to describe predominantly linear user–provider interactions, focusing on touchpoints, experience, and operational efficiency.	The same artifacts are reconfigured to map networks of actors and their interdependencies. Customer journey maps and service blueprints become systemic representations that analyze coordination, friction, and dependencies within a shared context.
Project outcomes	Outcomes are primarily materialized as tangible products or services aimed at functionality, usability, or communication.	Outcomes include both tangible deliverables and structural learning: insights into the system's relationships, dynamics, and structures, providing inputs for applied research.
Role of design within the project	Design fulfills a strategic or instrumental role: communicating results, developing artifacts, or supporting knowledge transfer.	Design is integrated as an epistemic agent insofar as it observes, models, and examines system relationships, making assumptions and intervention criteria explicit.
Knowledge generation	Knowledge derived from design tends to be applied and oriented toward the implementation of results.	Knowledge is articulated in a reflective, structural, and actionable manner, enabling interpretive frameworks for interactions and processes.
Validation and traceability criteria	Validation focuses on delivery and implementation; traceability between evidence, decisions, and iterations often remains implicit or fragmented.	Validation is structured as a traceable chain (observation, modeling, hypothesis, prototyping, and feedback), with iterations documented through versioned maps, agreements, and criteria, and reviewed with stakeholders to audit decisions and limits to generalizability.
Bias and framing management	Problem framing and team assumptions tend to remain implicit; bias is addressed reactively in response to friction with users or stakeholders.	Framing is treated as an explicit object of inquiry: assumptions are declared, narratives are contrasted in multi-stakeholder settings, inclusion and exclusion criteria are documented, and reviews are incorporated to prevent the premature closure of dissent.
Contribution to applied scientific research	Contributions tend to focus on aesthetic value and usability, without substantially changing the understanding of the phenomenon under study.	The scope of the research is expanded by incorporating a systemic perspective (technical, social, and institutional) and producing process evidence (iterations, decisions, and criteria) that supports applied research.

This contrast is not intended to establish a universal opposition between the two approaches. Rather, it highlights the operational differences observed in this case and discusses the methodological scope of design in complex contexts.

In this analysis, design artifacts function as tools for meaning-making and learning. They allow us to trace decisions, assumptions, and iterations, and to link abductive exploration with consistency criteria and intersubjective review. However, these artifacts are not neutral: their value depends on how frameworks are made explicit, biases are managed, and validation mechanisms are documented.

The contrast presented in Table 2 synthesizes the findings from the OA case. To do so, we identified the functions of the instruments in terms of observation, modeling, comparison, and transfer; extracted recurring descriptors linked to decisions and validations; and formulated categories for comparing instrumental and systemic design participation.

The results suggest that the systemic approach can help shift design from a predominantly instrumental function toward a cognitive and structural one, aligning with the team's prior work on interdisciplinary coordination, operationalizing systemic design thinking, and strengthening communities through environmental information (Mollenhauer et al., 2023a, 2023b; Rodríguez et al., 2025).

5.2.1. SYSTEMIC REFRAMING OF CUSTOMER JOURNEY MAPS AND SERVICE BLUEPRINTS

The systemic reframing of these tools shifted their unit of analysis from individual experience to episodes of multi-actor coordination. By incorporating the institutional backstage, temporalities, dependencies, and records of evidence, the maps moved beyond describing service experiences to bringing structural tensions into view. This shift connected experiential representation with research and design decisions, constituting one of the study's main methodological contributions.

5.3. METHODOLOGICAL TENSIONS AND LIMITATIONS OF SOD AND RTD IN SOCIO-ENVIRONMENTAL CONTEXTS

Gigamaps and other systemic artifacts are not neutral representations. In conflict-ridden socio-environmental systems, framing decisions can amplify certain narratives while downplaying others. This approach therefore calls for explicit cross-checking and validation mechanisms to ensure visualizations do not prematurely silence dissent.

Integrating design into applied research also complicates established criteria for rigor. RtD does not replace empirical evidence or its verification procedures, but it does introduce its own quality standards—such as auditability of the process, consistency across iterations and decisions, and explicit articulation of project limits.

In this context, design's epistemic value is strengthened when we can demonstrate how an artifact led to the redefinition of a hypothesis, variable, or intervention criterion, and what evidence supported that modification. This traceability enables us to distinguish between context-specific findings and potentially transferable learning.

5.4. SCALING, COSTS, AND TRANSFERABILITY CONDITIONS

In this case, implementing the support service during phase IT23I0066 marks the first evidence of institutional transfer. The findings and criteria from the thesis were revisited and adapted to guide the creation of support resources aimed at promoting adoption of the OA platform. This continuity is not a literal replication of the original prototype, but rather its adaptation to a new stage in the Observatory's development.

Although the support service represents situated knowledge with potential for transfer, scaling it up in a public context depends on conditions that this study cannot assess. These include institutional capacities to sustain the service, operational and maintenance costs, care protocols, and governance mechanisms. Consequently, the article's main contribution lies in its methodological clarification and the pilot-phase evidence it provides, rather than in a demonstration of long-term systemic impact.

From an applied research perspective, scalability does not depend on literal replication but on specifying which components can be retained, which require adaptation, and which indicators should be used to evaluate performance in other contexts. We thus frame long-term impact as a hypothesis to be tested in later stages using external metrics and longitudinal follow-up.

6. CONCLUSIONS

This case study—presented as an RtD project grounded in a thesis developed at the Environmental Observatory of Mining Projects (OA)—suggests that systemic design can be integrated into applied scientific research, contributing both to producing situated knowledge and to guiding the implementation of service solutions. In this case, the SOD and the LIP's Triple Diamond framework structured an iterative process in which systemically reframed gigamaps, customer journey maps, service blueprints, and prototypes functioned as instruments for observing, modeling, and testing assumptions about access to, understanding of, and use of public environmental information.

Methodologically, the results suggest that design's epistemic contribution is reinforced when decisions, intervention criteria, and iterations are explicitly documented, and when representations are subjected to intersubjective review. Under these conditions, design artifacts can serve as process evidence, although their validity remains tied to the case's context and scope. In practical terms, the support service functions as a systemic prototype: it generates situated feedback on institutional frictions, coordination, and dependencies that inform both service adjustments and a more structural understanding of the system.

The study's limitations are tied to the scope of validation: the findings come from piloting and proof-of-concept studies and do not amount to a longitudinal evaluation of the service's systemic impact (e.g., sustained changes in participation, effective information use, or institutional decisions). Moreover, systems modeling is not neutral and is shaped by framing decisions; future work should therefore deepen mechanisms for controlling bias, define external metrics, and conduct ongoing monitoring, while also exploring the conditions for scaling up (capacities, governance, interoperability, and costs) in public settings.

Thus, the study's contribution lies not in demonstrating the general superiority of systemic design or its equivalence to other scientific methods, but in clarifying the conditions under which its tools can help observe, model, and test relevant relationships in applied research.

REFERENCES

Bergamini, K., Ángel, P., Rugiero, V., Medina, J. I., & Mollenhauer, K. (2023). Building resilient communities: The Environmental Observatory for Mining Projects and climate change indicators. *Sustainability, 15*(8), 6947. https://doi.org/10.3390/su15086947

Bergamini, K., Ángel, P., Mollenhauer, K., Medina, J. I., Rugiero, V., & Rodríguez, J. (2025). The Environmental Observatory for Mining Projects: A system for the analysis of public environmental management information. In M. Vicuña & E. Giorgi (Eds.), *Intersections: Interdisciplinary research on architecture, design, city and territory* (pp. 99–115). Springer. https://doi.org/10.1007/978-3-031-76402-8_7

Blank, S. G. (2007). *The four steps to the epiphany: Successful strategies for products that win* (3rd ed.). K&S Ranch.

Cárdenas, C., Sosa, R., Moysen, R., & Martínez, V. (2010). Sustaining sustainable design through systemic thinking. *International Journal of Engineering Education, 26*(2), 287–292.

Chávez López, C. (2021). Diseño y sistemas complejos: Un enfoque multidimensional en el proceso de diseño. *RChD: Creación y Pensamiento, 6*(10), 1–16. https://doi.org/10.5354/0719-837X.2021.60895

Coughlan, P., Fulton Suri, J., & Canales, K. (2007). Prototypes as (design) tools for behavioral and organizational change: A design-based approach to help organizations change work behaviors. *The Journal of Applied Behavioral Science, 43*(1), 122–134. https://doi.org/10.1177/0021886306297722

Cross, N. (1999). Design research: A disciplined conversation. *Design Issues, 15*(2), 5–10. https://doi.org/10.2307/1511837

Culagovski, R., & Del Río Alemparte, C. (2022). Design as a driver for multidisciplinary teams: An applied research case in El Quisco, Chile. *diid—Disegno Industriale Industrial Design*, (76)12, 156–167. https://doi.org/10.30682/diid7622n

Design Council. (2019). *The double diamond: A universally accepted depiction of the design process*. https://www.designcouncil.org.uk/resources/the-double-diamond/

Findeli, A., & Coste, A. (2007). De la recherche-creation à la recherche-projet: Un cadre théorique et méthodologique pour la recherche architecturale. *Lieux communs, 10*, 139–161.

Frayling, C. (1994). Research in art and design. *Royal College of Art Research Papers, 1*(1). 1–5.

Glanville, R. (2024). The sometimes uncomfortable marriages of design and research. In P. A. Rodgers & J. Yee (Eds.), *The Routledge companion to design research* (pp. 10–23). Routledge. https://doi.org/10.4324/9781003182443-3

Laboratorio de Innovación Pública UC. (2017). *La co-producción del usuario en los servicios públicos*. Pontificia Universidad Católica de Chile.

Mollenhauer, K., del Río, C., Rodríguez, J., Silva, K., & Rugiero, V. (2023a). How to build resilient communities? The Chilean Environmental Observatory as an interdisciplinary research case driven by systemic design to empower through information. *In proceedings of Relating Systems Thinking and Design, RSD12*, Article 173. https://rsdsymposium.org/chilean-environmental-observatory/

Mollenhauer, K., Del Río, C., Rodríguez, J., Bianchi, D., & Riveros, S. (2023b). Logical Design Matrix (LDM): How to operationalize systemic projectual design thinking in complex contexts. *Human Systems Engineering and Design (IHSED 2023): Future Trends and Applications, 112*, 245–257. https://doi.org/10.54941/ahfe1004135

Mollenhauer, K., del Río, C., Rodríguez, J., Bergamini, K., Rugiero, V., & Medina, J. I. (2024). Multilevel Information Delivery Strategy (MIDS): A strategic design-based model and method for equitable access to environmental information. *Human Systems Engineering and Design (IHSED 2024): Future trends and applications, 158*, 325–343. https://doi.org/10.54941/ahfe1005556

Mollenhauer, K., Moraga, E., & Bernasconi, R. (2020). Modelo instrumental para proyectos complejos: Poliedro Propuesta de Valor Académico. *Bitácora Urbano Territorial, 30*(2), 127–140. https://doi.org/10.15446/bitacora.v30n2.81661

Montalván Lume, J., Soria Morales, C., Hopkins Barriga, A., Ascue Yendo, R., & Ajito Lam, E. (2019). *Guía de investigación en diseño*. Pontificia Universidad Católica del Perú, Vicerrectorado de Investigación. https://cdn02.pucp.education/investigacion/2016/06/12214732/guia-de-investigacion-en-diseno.pdf

Muratovski, G. (2016). *Research for designers: A guide to methods and practice*. SAGE.

Palmarola, H. (2001). Entrevista a Gui Bonsiepe. *ARQ (Santiago)*, (49), 54–56. https://doi.org/10.4067/S0717-69962001004900029

Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Business.

Rodríguez, J. (2023). *Servicio de acompañamiento del Observatorio Ambiental de Proyectos Mineros* [Proyecto de título de pregrado no publicado]. Pontificia Universidad Católica de Chile.

Rodríguez, J., Mollenhauer, K., del Río, C., & Bergamini, K. (2025). Designing to support communities in Chilean environmental management: The case of Environmental Observatory (EO) Support Service. *Proceedings of Relating Systems Thinking and Design, RSD13*, Article 60. https://rsdsymposium.org/chilean-environmental-management/

Salvatierra, R. (2021). Managing strategic participation through design principles: A model for value co-creation in service-based organizations. In W. Karwowski, T. Ahram, D. Etinger, N. Tankovic, & R. Taiar (Eds.), *Human systems engineering and design III: Future trends and applications* (pp. 69–76). Springer. https://doi.org/10.1007/978-3-030-58282-1_12

Sevaldson, B. (2015). Gigamaps: Their role as bridging artefacts and a new sense sharing model. In *Proceedings of the Relating Systems Thinking and Design*. https://rsdsymposium.org/gigamaps-as-artefacts/

Sevaldson, B. (2022). *Designing complexity: The methodology and practice of systems oriented design*. Common Ground Research Networks.

Systemic Design Toolkit. (s. f.). *Methodology*. https://www.systemicdesigntoolkit.org/methodology

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