Neusearch as Design Research within the framework of 'Arupa - the Implicate Order'

A.G.Rao

Abstract

This article proposes a paradigm shift in design research by introducing Neusearch within the framework of Arupa, the Implicate Order, understood as a tacit yet rigorous basis for design pedagogy, practice, and research. Drawing from formative experiences at the National Institute of Design (NID) and long engagement at IDC, IIT Bombay, the paper examines design not merely as a method, but as an embodied and reflective mode of inquiry. Influenced by interactions with Charles Eames, Gui Bonsiepe, Kohei Sugiura, Donald Schön, Howard Gruber, and R.K. Joshi, along with philosophical insights from J. Krishnamurti and David Bohm, the framework foregrounds dialogue, tacit knowing, and reflective engagement as central to design inquiry. Insights of Nigel Cross on "design as a discipline" and Christopher Alexander's "Pattern Language" further support this direction. Neusearch is articulated as a mode of inquiry oriented toward the unknown, where hypotheses evolve implicitly through engagement and interaction. Pedagogical experiments, metaphor-based tasks, and studio practices are examined as sites where this implicate order becomes operative. Professional and research projects, including the Bicycle for Rural Use and UNDP bamboo initiatives, demonstrate the interplay of tacit knowledge, technical reasoning, and social context.
In the context of AI-driven futures, the paper argues for a re-framing of design research that integrates embodied cognition, ethical reflection, and tacit processes. It proposes Arupa as a foundational lens for evolving design education and research beyond conventional disciplinary boundaries.

1.0 Introduction

Design as a discipline has long occupied a space between art, craft, and science. While its practice involves synthesis, intuition, and material engagement, its integration into academic frameworks required alignment with dominant notions of *research*, understood as systematic, objective inquiry aimed at verifiable knowledge. This alignment, though necessary, has also limited how design knowledge is recognized and articulated.

The need to see design as an independent domain of knowledge has been argued by thinkers such as Nigel Cross in Designerly Ways of Knowing (1), and by Christopher Alexander through the concept of Pattern Language (2). These perspectives suggest that design operates through structures of thinking that differ from conventional scientific inquiry.

Conventional research, rooted in scientific traditions, depends on clearly defined hypotheses, measurable variables, and replicable outcomes. Such an approach is effective where problems are well-defined in advance. In design, however, problems often emerge through engagement with materials, contexts, and users. Understanding develops iteratively through making, reflection, and interaction. This raises a critical question: *Can design inquiry be fully understood within existing research frameworks?*

This paper proposes an alternative mode of inquiry, referred to as '*Neusearch*', a process of seeking knowledge in situations of uncertainty, where hypotheses are tacit, evolving, and embodied. In Neusearch, inquiry is not driven solely by predefined

questions but unfolds through a dynamic interplay of perception, action, and reflection. While such processes may exist within conventional research, they remain largely unarticulated, particularly in academic contexts.

The articulation of Neusearch arises from the author's long engagement with design education and practice in India, beginning at the National Institute of Design (NID) and extending through decades at the Industrial Design Centre (IDC), IIT Bombay. Interactions with figures such as Charles Eames, Gui Bonsiepe, Kohei Sugiura, Donald Schön, and Howard Gruber, along with philosophical influences from Jiddu Krishnamurti and David Bohm, contributed to an understanding of design as a reflective and embodied practice.

Within this trajectory, a tacit framework gradually emerged, referred to here as Arupa - the Implicate Order (3). Arupa (unmanifest form) points to an underlying order from which forms arise. It is within this implicate domain that intuition, metaphor, embodied knowledge, and reflection interact to generate design insight.

This paper seeks to articulate this framework and examine its implications for design pedagogy, practice, and research. Through examples from teaching, studio work, and professional projects, it demonstrates how Neusearch operates as an integral component of design activity.

In the context of AI-driven futures, where analytical and generative tools are rapidly evolving, it becomes necessary to re-examine the foundations of design research. While AI can augment explicit knowledge processes, it does not engage with the embodied and tacit dimensions central to human creativity. The paper therefore argues for a re-framing of design research, one that integrates both explicit and tacit modes of knowing, and enables design to articulate its own epistemological foundations.

2.0 Research and Neusearch

The term *research* has historically come to denote a systematic mode of inquiry aimed at establishing knowledge through explicit hypotheses, measurable variables, and verifiable outcomes. Its strength lies in clarity, objectivity, and repeatability. However, such a framework assumes that the problem is clearly defined at the outset and that the path to knowledge can be structured in advance.

In design, this assumption does not always hold. The designer often begins not with a well-defined hypothesis, but with a problem situation: ambiguous, evolving, and embedded in context. Understanding emerges through engagement with materials, users, and environments rather than preceding it. This calls for recognition of another mode of inquiry, referred to here as *Neusearch*.

Neusearch may be understood as a process of seeking knowledge in conditions of uncertainty, where the hypothesis is not explicitly formulated but exists in a tacit and evolving form. Unlike scientific research, which moves from hypothesis to validation,

Neusearch moves from engagement to emergence. It is a mode of inquiry in which direction, structure, and meaning unfold through interaction with the situation.

This mode of inquiry resonates with Donald Schön's notion of *reflection-in-action*, (4,5) where thinking and doing are inseparable, and where the practitioner engages in a continuous dialogue with the situation. It also aligns with Michael Polanyi's concept of *tacit knowledge*, (6) where knowing is rooted in experience and cannot be fully articulated in advance. However, Neusearch extends beyond both by situating these within a broader design-oriented search for meaning, where material, context, and societal need, actively shape the inquiry.

A useful distinction may therefore be made:

- **Scientific Research** begins with a defined hypothesis and proceeds toward validation.
- **Reflection-in-Action (Schön)** operates within action, refining understanding through feedback.
- **Tacit Knowledge (Polanyi)** underlies both as an implicit base of knowing.
- **Neusearch**, in contrast, begins without a fully formed hypothesis and allows direction and meaning to emerge through engagement.

In practice, Neusearch is rarely directionless. It often acquires a *strategic orientation* grounded in real-world concerns such as societal needs, sustainability, and resource utilization in addition to a 'Vision of well-being'. For instance, the reuse of industrial waste, such as powdered bamboo generated in craft and mass production, can become a starting point for inquiry. Similarly, engagement with rural contexts, appropriate technologies, and underexplored material possibilities can guide the Neusearch process. Potentials of 'Local small-scale entrepreneurships and Innovation' can become a guiding factor in such strategic direction.

Field immersion plays a crucial role in this mode of inquiry. Visiting sites, interacting with people, documenting practices through sketches and photographs, and observing everyday innovations create a ground for re-looking and re-framing. In the Bicycle for Rural Use project, what began as observation of load-carrying practices evolved into a deeper inquiry involving both technical analysis and tacit understanding of user ingenuity. The process revealed a dynamic interplay between experiential knowledge and scientific reasoning, where neither alone would have been sufficient.

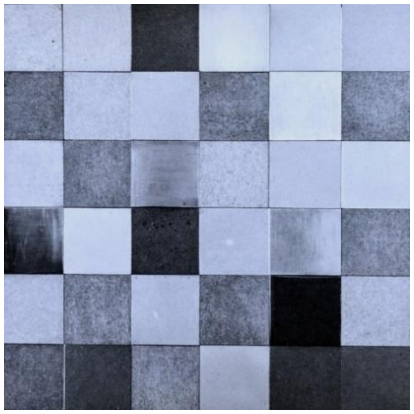
3.0 Nuesearch-1: In Design Pedagogy

Design pedagogy provides a fertile ground for Neusearch, where inquiry unfolds through engagement with material, abstraction, and experience. The following tasks, conducted at NID and IDC, are presented not as instructional methods but as *evidence* of a mode of inquiry where knowledge emerges through making, perception, and reflection

3.1 Texture Task in Aluminium: Composition with textured elements

A task to explore textures in Aluminium set by Prof.Kumar Vyas for us, resulted in discovering /producing 6 to7 new textures on 3mm thick aluminium sheet pieces of 5cmX5cm, and composing them.

One of our colleagues Sethuraman discovered unique chemical finish with 'Concentrated nitric acid + sodium meta phosphate'. Chemists had paid little attention to the 'aesthetic quality' in the reaction earlier.



1

We explored and came out with following textures

3.1.1. Uniform smooth mat finish produced by multi directional strokes with fine sand paper. Directional strokes were eliminated with distributed strokes which needed a skill.

3.1.2 Unidirectional smooth sand paper finish. This when orientation is changed by 90°, would look quite different and becomes another finish. This is an optical phenomenon and becomes relevant as an aesthetic trait not as an engineering property.

3.1.3 Buffed shiny finish.

3.1.4 Rough uniform wire brush finish.
This was produced with a wire brush on an electric drill.

3.1.4 Rough etched surface with concentrated hydrochloric acid

3.1.5 Unique texture by dipping al piece in Concentrated nitric acid + sodium meta phosphate

3.1.6 Mat finish with dilute Sulfuric acid.
We missed the historic significance at that time. We could generated specific names for each.

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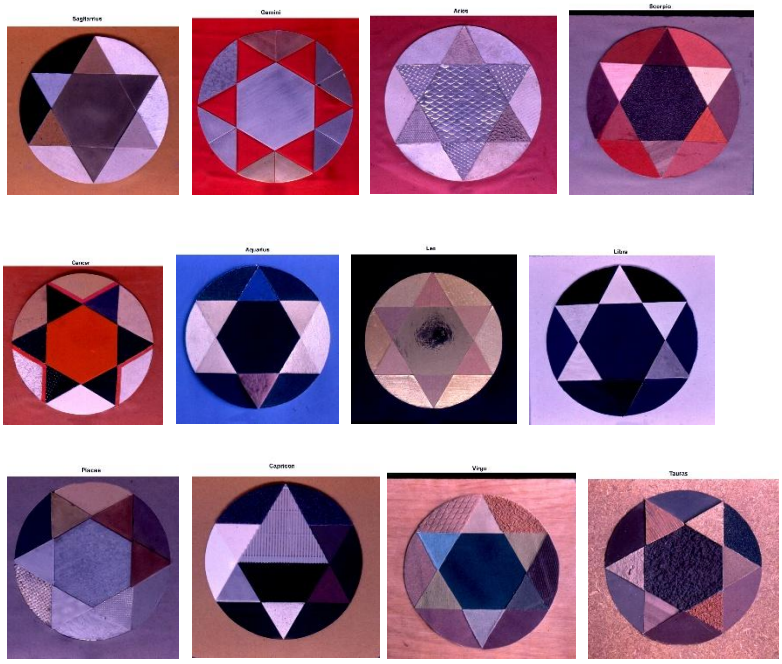
1. One of the compositions done as 'Texture Task'.

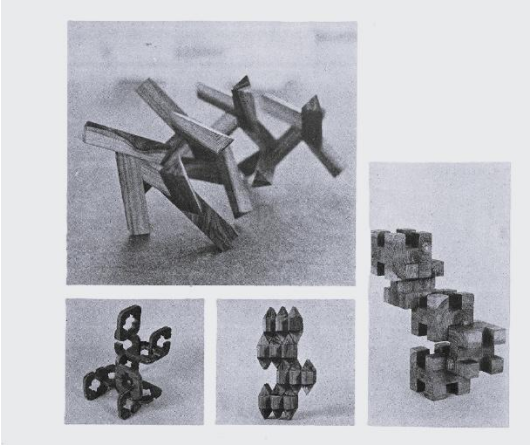
3.2. Expression of Zodiac signs through colour and Texture

This was the task set by me for m-des students. Expression to be brought through ‘colour and texture’ in any material. Students innovated and produced new textures on thin metal sheets physically by sanding, buffing, pressing under a hydraulic press, etc,.



3.3 Module and Growth

This task initiated at Hfg ulm, was carried throgh NID and IDC. It neusearch frame work for Imgination in the manufactured zone with 3D materials



In this task, (7) students developed an original module capable of systematic growth. Through this process, they engaged with material properties, geometric constraints, and structural possibilities.

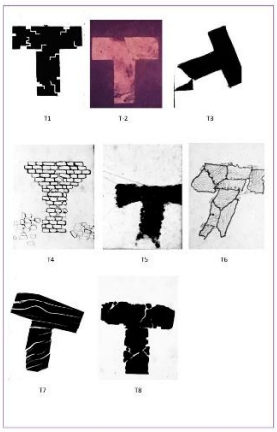
The exercise enabled them to understand how a simple unit can generate complex configurations through rules of transformation and extension. Such modular thinking nurtures imagination not as free abstraction, but as *structured emergence*.

This approach can be extended beyond physical form to conceptual domains such as services, systems, and organizational structures. In this sense, the task establishes a ground for research-oriented thinking, linking design exploration to **system thinking**, where relationships, patterns, and growth processes become central.

3.4 Metaphors and Meanings as Vehicles for Design Inquiry

Metaphors and Meanings play a major role in creative thinking. Tomas Maldonado's definition of Industrial Design, accepted by ICSID in late sixties, *"Industrial design is a creative activity whose aim is to determine the formal qualities of objects produced by industry. These formal qualities are not only the external features but are principally those structural and functional relationships which convert a system to a coherent unity both from the point of view of the producer and the user. Industrial design extends to embrace all the aspects of the human environment which are conditioned by industrial production", (*)* commits the profession for a contextual creative output.
Methods in creative problem solving have originated in a common psychological domain applicable to any field. In Architecture and Design, creativity conventionally has its 'tacit' presence as Individual traits (Intuition, feel, etc,). Adopting these methods as a 'research tools' strengthens design pedagogy in research zone as group.
I introduced 'techniques of creativity' to harness 'Imagination'. As a part of foundation task, these had a significant bearing.

- A task in 2D form was set as to depict, Letter 'T', becoming old along with analogies introduce by WJJ Gordon in 'Synectics-training' (8). The task, to be done in a limited time frame. made impact on graduate engineers and architects.



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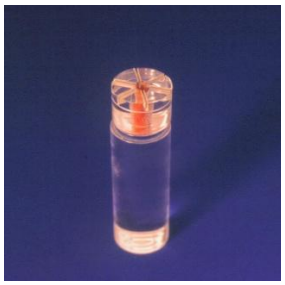
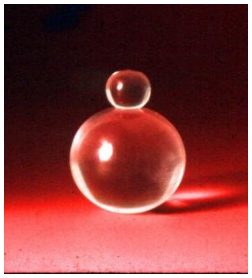
* Maldonado's definition was **ratified at ICSID General Assembly (London, 1969)**

Metaphor-based tasks, such as expressing a letter “T” becoming old” engage the students in transforming abstract ideas into visual and material expressions within constrained time frame.

- Metaphor based perfume bottles
  A task done to learn 3d-form was product based without strict production constraints, opened up Imagination using metaphoric base connecting to the way perfume is perceived. (9)

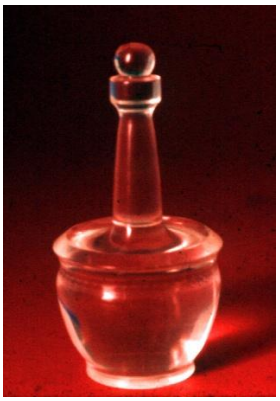

Vortex


Parijatha


dew drop


Clove


Swan


Makaranda

Parijatha and Makaranda are names of flowers

Such exercises resonate with George Lakoff’s view of metaphor as fundamental to human cognition (10), where abstract concepts are understood through embodied experience. They also align with W.J.J. Gordon’s *Synectics* (11) which uses analogical thinking as a structured method for creative discovery. In this context, metaphor functions not merely as a representational tool, but as a means of inquiry, bridging perception, imagination, and form.

While the outputs of these tasks provide visible evidence of exploration, the deeper impact lies in changes in the learner’s perception and engagement. Student narratives often reveal moments of hesitation, conflict, and transition, where tacit processes become active. These moments indicate a shift in Inner Order, where judgement moves from externally imposed correctness to internally guided perception. Such transformations suggest that design pedagogy, in a Neusearch framework, operates not merely at the level of skill acquisition but at the level of perceptual and cognitive reorganization.

4.0 Nuesearch-2: Dialogues with Mentors

Dialogues with mentors opened new ways of looking at 'Design Research'.

4.1 In his interaction with us, Charles Eames brought attention to the question of values in design. His simple comparison, from stainless steel plate to silver, to gold, and finally to the banana leaf, shifted the focus from material value to contextual and experiential value. This revealed that design cannot be understood purely through industrial or economic parameters, but must be situated within cultural, ecological, and human contexts.

This insight had a lasting impact in positioning traditional practices not as remnants of the past, but as sources of meaningful design knowledge. It opened a direction where Neusearch begins with a re-seeing of what already exists, allowing deeper values to emerge through attentive engagement.

4.2 Informal discussions with Sugiura Kohei introduced a different dimension to design inquiry. His suggestion to view design as a programme expanded the scope of thinking from isolated objects to structured processes and relationships (12). More significantly, his analogy of the archer, who through total attention sees only the target, pointed to the role of focused awareness in creative work.

This notion of total attention, later articulated as Active Silence, revealed that the quality of perception itself determines the depth of inquiry. In the context of Neusearch, this suggests that insight does not arise merely from method or effort, but from a state of attention where distractions are minimized and the situation is perceived in its wholeness.

4.3 My interactions with Prof. Gui Bonsiepe brought a decisive shift in my understanding of design as a knowledge-generating activity rooted in socio-economic context. His emphasis on design for the disadvantaged and his articulation of "endogenous design research" revealed that design inquiry must emerge from local realities rather than borrowed frameworks. (13)

Through close engagement during his visit to IDC, I observed his method of working—where dialogue, sketching, and systematic recording formed an integrated process of inquiry. His ability to trigger imagination in students through simple but strategic interventions (such as scaling a hinge ten times) demonstrated how tacit understanding can be activated and extended into design exploration.

Bonsiepe's insights extended design beyond form and function toward interface, human action, and knowledge production (14). This connects with my concept of 'Neusearch' not merely as solving problems, but as generating new meanings and directions through sustained engagement with context, material, and society.

4.4 Donald Schön at MIT introduced me to Polanyi and the idea of *tacit knowledge*. The course I attended, *Metaphors in Learning and Design* (1980), conducted by him along with Jeanne Bamberger, was unique. It was dialogical, with a small group of students and no formal lectures. He brought out the tacit dimension of metaphor, and the role of *naming* as a bridge between figural and formal thinking, giving insight into what he later articulated as "generative metaphor."
This enabled me later to see *language as a resource for Neusearch*, in the framework of 'Arupa- the Implicate order' (15)

4.5 Dialogues with Prof. H. Gruber took my understanding of creativity beyond techniques such as Synectics, toward creativity as a *lifelong performance of the person as a whole*. Known for his studies on Darwin, Prof.Gruber, pointed out Mahatma Gandhi's 'Creativity' as an integrated expression of values, action, and life process, not just as limited strategies to win freedom for India. (16)

4.6 Listening to J. Krishnamurti's talks in Mumbai, along with two interactions with him in a small group, pointed to the need to see beyond thought as the sole instrument of understanding. (17) The concept of Inner Order as a necessary ground for both creative performance and the learning process began to take root.

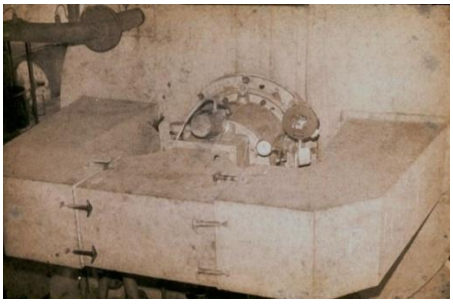
4.7 My "dialogues" with David Bohm were in an *Arupa mode*, as I never met him nor communicated with him directly. He became a mentor beyond physical interaction. His dialogues with J. Krishnamurti led me read his works (18,19). But his dialogue with Biederman brings a significant connection between 'scientific and aesthetic' orders, aligning well with 'Arupa the Implicate Order'(20).

4.8 Hours of discussion with Prof.R.K.Joshi, a well-known calligrapher and a colleague at IDC, gave a pedagogic inspiration, when I began connecting 2D letter forms to 3D objects, as a ground for 'Neusearch' to learn design.

5.0 Nuesearch-3: Professional Projects, Research in Practice

There has been a long tradition in design practice where consultants have influenced the scope of projects beyond the initial brief. In such situations, *design research* becomes embedded within practice, often implicitly. In the projects described below, the research dimension did not arise from formal methodologies alone, but from a continuous interaction between observation, technical understanding, and intuitive judgment. Reframing the problem as the project progressed, is a tacit research skill consultant designers acquire by dealing with different kinds of projects.

5.1 Boiler Design Project



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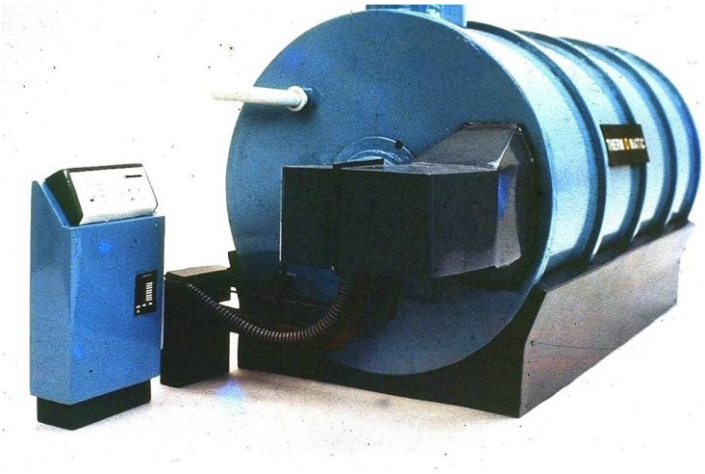

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In a boiler design project for export for Thermax (earlier, Wanson India), the initial brief was limited to improving the visual appearance of an already engineered unit. The boiler, a large cylindrical structure, had two ducts connected to the central burner, on either side, to circulate hot air back to increase thermal efficiency. Two ducts were kept on either side by engineers as a feature of symmetry. This created visual continuity in addition to persistent leakage problems at multiple joints. Aesthetic response to the visual continuity between the ducts and the body raised a fundamental question: why were two ducts necessary? Consultation with a heat transfer expert revealed that what mattered was not the number of ducts, but the total exit area for hot air. This led to a critical reframing: *a single duct with equivalent area, supported by an internal deflector, could perform the same function*.
This shift reduced three joints to one, resolved leakage issues, lowered cost, and enabled a more integrated and "flowing" form between the cylindrical body and the burner interface.

Aesthetic response to the control unit, which did not have the necessary visual weight, to match the huge size of the cylindrical body of boiler resulted in increasing the size of it with better proportion. Cost remained due to the full use of standard size of sheet metal. Parallel refinements in the control unit like, reversing the panel slope for ergonomic clarity, grouping controls functionally, and organizing cables through a connecting base, brought coherence to both operation and appearance. (21,22).

- **Research Insight**
  The key insight was that design intervention can emerge from *reframing system assumptions with an aesthetic response*. By questioning the necessity of existing

elements, it became possible to achieve simultaneous gains in function, cost, manufacturability, and form.

- **Tacit and Explicit Interplay**
  - **Tacit**: The initial discomfort with the "non-flowing" form of the ducts and the intuitive search for integration led to questioning their necessity.
  - **Explicit**: This intuition was validated through heat transfer reasoning, ensuring that performance was maintained while simplifying the system.
- **Design Research Perspective**
  The project demonstrates how design research can operate within practice, beginning with perceptual insight of aesthetic nature, engaging with technical knowledge, and arriving at a solution that redefines the system rather than merely optimizing it.

5.2 Electronic Voting Machine (EVM): Aesthetic Articulation of Trust

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2

The Electronic Voting Machine (EVM) project at IDC, IIT Bombay (1988), required the design of a device that could replace the traditional ballot system while being operated by non-technical personnel such as school teachers and polling staff across diverse Indian conditions (23). While the electronic architecture was developed by BEL and ECIL, the design challenge lay in translating an unseen electronic system into a form that would be **understood, trusted, and accepted by the public**.

Field visits to polling booths revealed that the act of voting was not merely functional but carried psychological and cultural weight. An aesthetic response, grounded in trained tacit perception, identified the need for **clarity, neutrality, and reassurance** in the visual and tactile experience of the machine.

This led to the development of the **elliptical button**, whose form resonated with the familiar gesture of a thumb impression, associated with illiterate and an embodied act of legal consent in India. The layout ensured a direct and unambiguous relationship between candidate and action, minimizing cognitive load. The colour scheme was deliberately kept neutral and non-partisan, avoiding any unintended symbolic associations.

A critical design decision was to express **security through visible means**. Since the electronic integrity of the system was not perceptible, the design incorporated physical cues like robust casing, simple interface, and the possibility of traditional sealing (such as wax seals), to make security *seen and trusted*. At a system level, the machine was designed as a **standalone unit**, without connectivity to external networks, reinforcing both actual and perceived reliability.

- **Research Insight**

The key insight was that in a democratic public domain, design must translate invisible system properties, such as security and integrity, into **perceptible aesthetic and tactile cues**. Aesthetic response here functions as a form of trained tacit knowledge that enables the articulation of trust.

- **Tacit and Explicit Interplay**
    - **Tacit**: Sensitivity to user anxiety, cultural gestures (thumb impression), and the need for visual reassurance in a public electoral context.
    - **Explicit**: Translation into button form, layout logic, material robustness, colour neutrality, and standalone system architecture.
- **Design Research Perspective**

The project demonstrates how design research can operate at the level of socio-technical systems, where aesthetic articulation becomes critical in mediating between complex technology and public trust. Here, perception, symbolism, and function converge to give form to democratic values.

5.3 Street Lamp for Crompton Greaves: Reframing under Constraint

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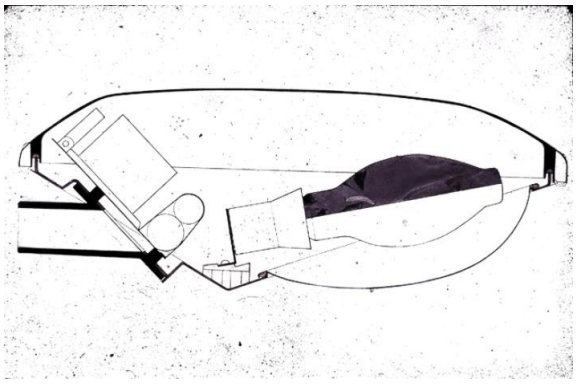

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The street lamp project for Crompton Greaves (1993–94) began with a conventional objective: to develop a cost-competitive product in a market dominated by established players like Philips. A common industry approach was to incorporate adjustable swivel mechanisms to accommodate different road conditions, an added feature that increased cost. (24,25)

An initial aesthetic and systemic reading of the problem led to a reframing, rather than adopting competitor features, the question shifted to **what fundamentally needed to vary**. Through engagement with lighting requirements, it was understood that only three angular conditions were sufficient for typical road types. This led to the development of a **stepped internal base**, achieving the required variation without movable parts, reducing 'cost' while simplifying the system.

The evolution of form emerged through an iterative perceptual process involving sketches, full-scale drawings, and rough thermocol (Styrofoam) models. This enabled me (the designer) to work within "fuzzy boundaries," allowing tacit judgement of proportion, balance, and integration. As internal components such as the transformer were incorporated, the form evolved into a **horizontally balanced configuration**, where visual proportion and structural logic reinforced each other.

A significant aspect of the project was the **extension of design activity beyond the formal capabilities of the company**. Crompton Greaves did not have the facilities to develop working prototypes at this stage. This led to the involvement of small external fabricators and process experts, enabling the exploration of alternative making methods such as **FRP non-pressure moulding** for the top cover, along with innovative hinge detailing suited to low-cost production.

Design inquiry thus extended into **back-end processes of making**, where material behaviour, fabrication constraints, and assembly logic were actively explored to arrive at a viable working prototype, which the organization itself was not equipped to realize internally at that stage.

Field observations of installation and maintenance further informed the design. Issues such as handling difficulty, insect ingress, and water leakage were addressed through features like transformer handling provisions, sealed enclosures, and gasketed joints. These refinements reinforced the importance of engaging with real conditions of use, beyond the drawing board.

- **Research Insight**

The key insight was that design innovation can emerge through reframing the problem at a system level, rather than following established feature sets. Aesthetic response, as trained tacit knowledge, guided this reframing and enabled integration across function, cost, and form.

- **Tacit and Explicit Interplay**

    - **Tacit**: Perceptual judgement of form, proportion, and system coherence; intuitive rejection of unnecessary features.
    - **Explicit**: Translation into stepped geometry, alternative fabrication processes (FRP moulding), hinge mechanisms, and cost-effective configurations.

- **Design Research Perspective**

The project demonstrates that design research operates not only in front-end form generation but also in the **back-end processes of making and realization**. A neu-search process was involved in finding fabricators who were willing to work within our low budget.
By extending the design process to include external collaborators and alternative fabrication methods, the designer actively constructs the conditions required for innovative solution. This can be seen as an exclusive feature of 'design research'.

6.0 Research Projects

Two sponsored research projects assigned to IDC, 'Bicycle for Rural Use', funded by DST, India and 'Tools, Small Technologies and Finishes for Bamboo and Rattan' funded by UNDP, validate the notion of 'Nuesearch' for design Research' in a significant way. (26,27).
The project, 'Bicycle for Rural use' undertaken in 1978-81 is discussed in detail below.

6.1 Bicycle for Rural Use: A Model Case of Design Research


The Bicycle for Rural Use project, undertaken at IDC, IIT Bombay in the late 1970s,

began not as a formally defined research problem, but as a shared observation arising from field experience. During travels through rural India, it became evident that bicycles were being used far beyond their intended purpose—as carriers of milk cans, coconuts, gas cylinders, laundry, animals, and even as mobile livelihood systems.

This observation did not immediately translate into a hypothesis. Instead, it initiated a process of inquiry grounded in curiosity, engagement, and re-looking—characteristic of what has been described earlier as Neusearch.

An interdisciplinary team formed organically around this inquiry. Engineering expertise in energy, aerodynamics, and structural behaviour interacted with design-led observation and making. The team was not structured by discipline but shaped by the evolving nature of the problem itself.

A critical early moment arose during discussions with the Department of Science and Technology, where the very premise of the project was questioned: *how could such widespread use of bicycles for load carrying be claimed without formal survey data?* This revealed a fundamental tension between **lived observation** and **institutional validation**. What was evident in practice required translation into accepted forms of knowledge.

6.1.1 From Observation to Pattern

The project moved into systematic documentation through a photographic survey conducted across multiple regions of India. This revealed not isolated instances, but **recurring patterns** in load types, load placement, and balancing strategies.



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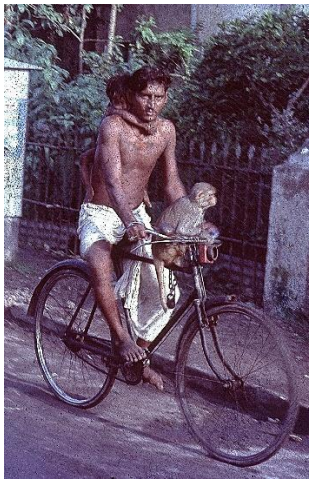


For example:

- Rear stacking of coconuts shifted the centre of gravity backward
- Symmetrical hanging of milk cans improved balance but introduced oscillation
- Flexible loads adapted to frame geometry but caused dynamic instability
- Live loads introduced continuous, unpredictable movement

These observations transformed the bicycle from a "product" into a **micro-logistics system shaped by user ingenuity**.

6.1.2 Local Innovations: Dosa Bicycle

Beyond load carrying, certain adaptations revealed a further level of ingenuity, where the bicycle was transformed into a **mobile livelihood system**. A striking example was the "dosa bicycle," where the cycle was modified to carry not only ingredients but also a working cooking surface, effectively becoming a moving food stall.

In this case, the bicycle integrates multiple functions—transport, storage, preparation, and service—within a single structure. Balance is no longer only a mechanical concern but is intertwined with usability, access, and workflow. Such adaptations demonstrate that users are not merely coping with constraints but actively reorganizing the system to create new possibilities.


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These observations—ranging from load balancing to system-level adaptations—indicated that the principles governing stability, effort, and efficiency were already

embedded in practice. This created the need to examine these phenomena through structured analytical studies."

6.1.3 Cost comparison, load distribution studies

.NO.	EQUIPMENT	MAX. LOAD CAPACITY . KG.	MAX. LOADED SPEED KM. PER HR.	POWER REQUIRED H.P.	EQUIPMENT COST Rs.	WORKING COST PER HOUR Rs.	REMARK
.	MAN	50-100 K	0.25	-	-	6.50	1) CAPACITY DEPEND ON MAN 11) SMALL DISTANCE
.	BULLOCK CART	500-800	2-3	-	6000	9.00	1) SLOW SPEED 11) ROUGH ROAD 111) CHEAP LABOUR
.	TWO WHEEL TROLLY (MANUAL)	100-200	1-1.5	-	600	7.00	SLOW SPEED
.	THREE WHEEL TROLLY	200-600	1-1.5	-	1000	10.00	SHORT DISTANCE
.	FOUR WHEEL TROLLY	500-800	1-2	-	1500	10.00	SHORT DISTANCE
.	WALKAWAYS	1000-1500	2-2.5	2-3	25000	-	1) SHOP FLOOR 11) SMOOTH ROAD
.	THREE WHEELER	500	20-30	10	25000	14.00	1) SMALL LOAD 11) HIGH SPEED
.	PLATFORM TRUCK	2000	9	3-6	35000-50000	8.00	1) HEAVY LOAD 11) SLOW SPEED 11) INSIDE THE FACTORY.
.	POWERED FOUR WHEELER	1500	15	16	50000	12	1) HEAVY LOAD 11) DUMPING FACILITY

- Cost comparison with other modes to know the advantage of carrying loads on Bicycle.

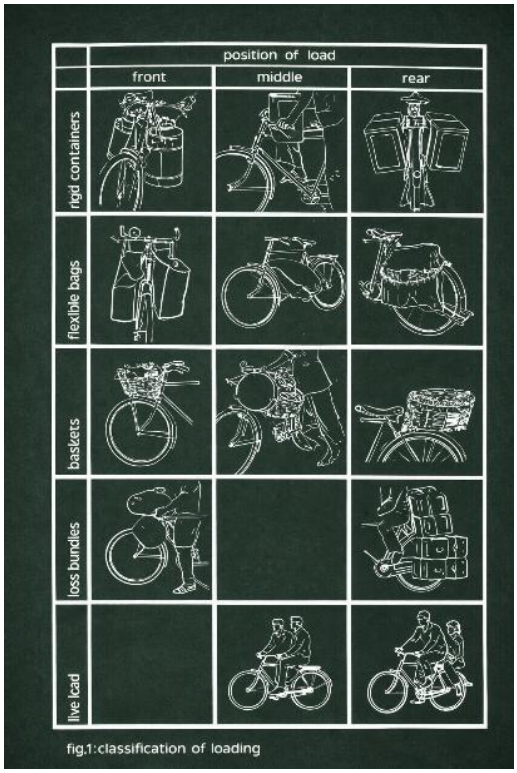
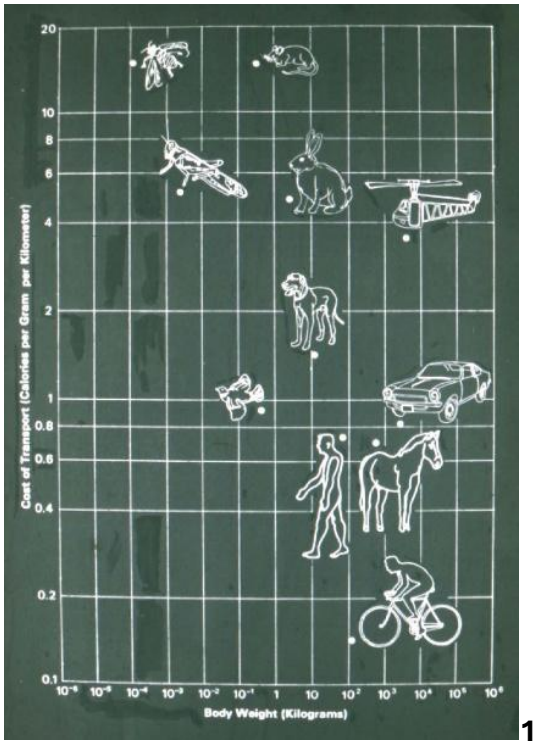


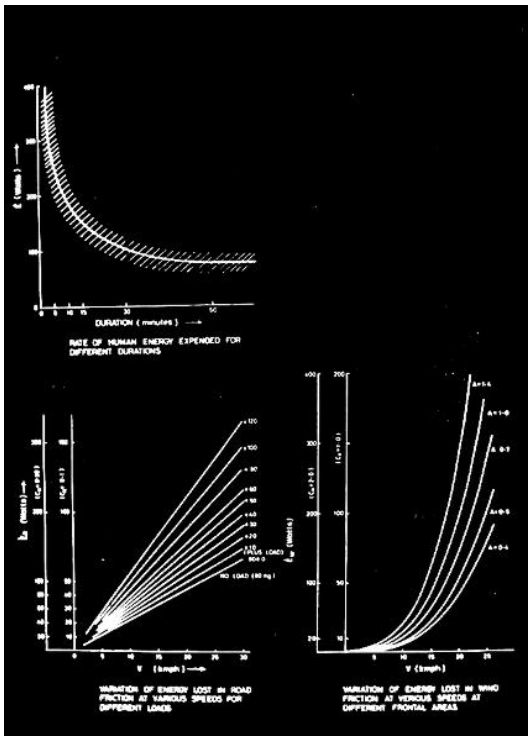
fig.1:classification of loading

- Systematic analysis of load carrying while riding gave insight into the scope of structural modifications.

6.1.4 Energy Consumption and Wind resistance



1

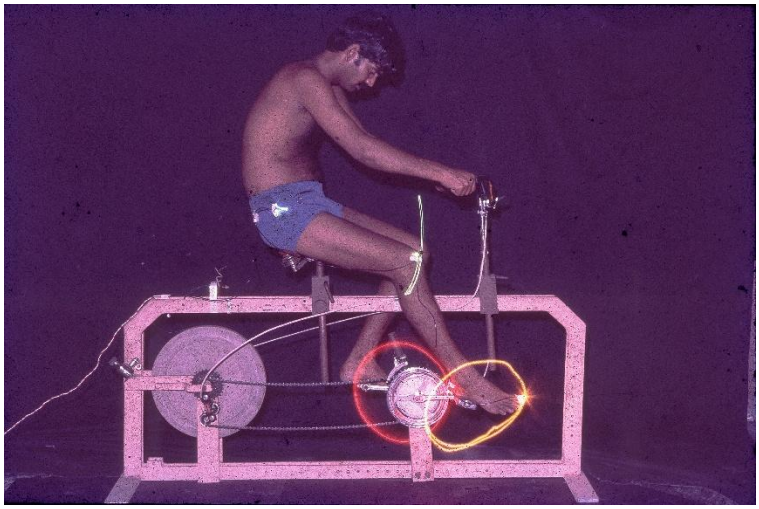


2

- 1.Energy consumption comparison across wide spectrum gave a comparative picture of bicycle riding.
- 2.Wind resistance study helped in understanding the need for riding at low speeds for efficient carrying of loads. General development of bicycles in the west was in another direction of high-speed riding, for sport.

6.1.5 Static Ergonomic Rig

A static rig was designed and built for anthropometric studies to suit tall and short riders.



6.1.6 Dynamic rig for stability Studies

- A dynamic rig was built with possibility change the fork angle and measure the movements of handle to find the optimum positions while riding with loads. These were studied by plotting on the graphs with instruments kept behind.

6.1.7 Interplay of Tacit and Explicit Knowledge

A defining feature of the project was the interaction between tacit and explicit modes of knowing:

- **Tacit (Embodied, Experiential)**
    - Users' balancing skills developed through practice
    - Informal innovations (attachments, load distribution, pushing strategies)
    - Designer's intuitive recognition of patterns in field observations
- **Explicit (Analytical, Measurable)**
    - Energy efficiency comparisons across modes of transport
    - Wind resistance vs velocity studies
    - Ergonomic measurements using static rigs
    - Stability and load distribution analysis

These were not sequential stages but operated in **continuous interplay**. Tacit insights guided what to measure; analytical results, in turn, sharpened perception.

6.1.8 Research Insight

The central research insight of the project may be stated as follows: The bicycle in rural India is not merely a vehicle but an evolving system, where user-driven adaptations reveal underlying principles of load distribution, balance, and energy efficiency.

This led to a crucial shift: From designing a *new bicycle*, to understanding an *existing adaptive system*. This shift reflects a movement from imposing solutions to uncovering an already existing order within practice.

6.1.9 Neusearch Process in the Project

Seen in retrospect, the project clearly demonstrates the structure of Neusearch:

- *Tacit Trigger*
  Field observation of unusual load-carrying practices
- *Immersion and Documentation*
  Photographic survey, field visits, conversations
- *Pattern Recognition*
  Classification of load types, strategies, and behaviours
- *Analytical Engagement*
  Energy, stability, aerodynamics, ergonomics
- *Iterative Reflection*
  Continuous movement between observation and analysis
- *Conceptual Shift*
  Reframing bicycle as a system rather than object.

6.2 Neusearch at a System Level: Bamboo Initiative with UNDP

Another significant project, *Tools, Small Technologies and Finishes for Bamboo and Rattan*, supported by UNDP and undertaken at IDC, extended the notion of Neusearch to a system level within an academic setting. The project moved beyond artefact design to engage with tools, processes, and craft practices as an integrated domain of inquiry.

Subsequent support from the Khadi and Village Industries Commission enabled training programmes across the country, where hundreds of craftspeople were introduced to new tools and small technologies. This engagement repositioned craft not as a traditional activity, but as a domain for contemporary design intervention.

The initiative also led to the establishment of *Bambu Studio* at IDC, supporting a graduate elective titled *Craft, Creativity and Postmodernism (CCPM)*. Here, Neusearch operated as a pedagogic and research framework, enabling students to engage with craft through making, reflection, and system-level understanding within a technological university context.

Extending this work beyond the academic domain, a company, *AGBambu Style*, was initiated by the author under the Society for Innovation and Entrepreneurship (SINE), IIT Bombay, to develop and supply toolkits to craftspeople across the country. This initiative carried a clear social objective of reaching disadvantaged communities through design-enabled interventions.

Further dissemination of knowledge has been supported through the author's website (www.agrao.in), which provides open access to resources related to bamboo craft and design.

This project demonstrates the potential of Neusearch to operate beyond individual inquiry, extending into **collective, systemic, and socially oriented modes of knowledge generation**.

7.0 Towards Neusearch as a New Order of Inquiry

The pedagogic experiments at NID and IDC, the professional projects undertaken for industry, and the government-supported initiatives such as the *Bicycle for Rural Use* and the UNDP bamboo programme together indicate the need for a rethinking of design research. What emerges through these engagements is not merely an extension of existing research frameworks, but a shift in how inquiry itself is understood in design. This paper has articulated this shift through the notion of **Neusearch**, a mode of inquiry that operates in conditions of uncertainty, where direction and meaning evolve through engagement rather than being fully defined at the outset. Seen through the lens of *Arupa – the Implicate Order*, 'Neusearch' may be understood as a process of unfolding latent order embedded in situations, materials, and human experience.

7.1 From Method to Mode of Inquiry

Conventional research frameworks emphasize method as the primary driver of inquiry. In design, however, the situation often precedes method. The designer enters a context that is not fully understood, where the problem itself is evolving. In such conditions, rigid adherence to predefined methods can limit discovery.

Neusearch shifts the emphasis from method to **mode of inquiry**. It recognizes that understanding emerges through a dynamic interaction between perception, action, and reflection. Method, in this sense, is not abandoned but becomes adaptive, shaped by the unfolding nature of the problem.

7.2 Interplay of Tacit and Explicit Knowledge

A defining characteristic of design inquiry is the continuous interplay between tacit and explicit knowledge. Tacit insight determines what is worth examining; explicit analysis sharpens and extends that insight. The projects discussed in this paper demonstrate that meaningful design research emerges when this interplay is sustained, rather than when one mode dominates the other.

7.3 Design Practice as Knowledge Generation

The examples discussed in this paper demonstrate that design practice is not merely an application of knowledge, but a site of knowledge generation. In the boiler project, aesthetic perception led to reframing an engineering assumption. In the EVM, visual articulation made invisible security perceptible in a democratic context. In the street lamp, cost constraints led to structural and process innovation. In the bicycle project, field observation and experimental rigs revealed system-level understanding. In each case, knowledge emerged through action.

Tacit perception guided inquiry, while analytical reasoning validated and extended it. This continuous interaction between tacit and explicit modes forms the core of design research.

7.4 Implications for Design Research and Education

If design research is to be understood through Neusearch, design education must create conditions for such inquiry. Studio-based learning, material exploration, and open-ended tasks are not merely pedagogic tools but grounds for research-oriented thinking. This has implications for advanced research programmes, including PhDs in design. Such programmes must recognize:

- reflective practice as a legitimate mode of inquiry
- articulation of tacit processes
- project-based exploration where knowledge emerges through making and engagement, with incorporation of tools for 'generalisation'. This enables an intellectual discourse to build the 'knowledge' relevant 'design' with its own epistemological foundations.

7.5 Neusearch in the Context of AI

The emergence of AI introduces new possibilities and challenges for design research. AI systems are capable of processing large volumes of explicit knowledge, identifying patterns, and generating responses at high speed. However, they operate primarily within the domain of articulated information.

Neusearch, as described here, is grounded in **embodied perception, tacit judgement, and contextual engagement**. These dimensions are not fully accessible to AI. While AI can augment design processes: supporting analysis, visualization, and exploration, it does not replace the human capacity to perceive, interpret, and respond to situations in a lived and meaningful way. These remain central to human 'Intelligence and Inner Order', in the framework of Arupa.

7.6 Role of inner Order

The special traits of Neusearch : embodied perception, tacit judgement, and contextual engagement, are closely related to what is referred to here as Inner Order. Arupa, the Implicate Order, addresses this in the frame work of working Orders. Thus in WO1, Neusearch operates with in the existing economic and political frame works and societal values, In WO2, it takes the narrow-specialised disciplines to broader new Orders. In WO3, it can address the fundamental values, projecting into a possible new society based on Compassion and absence of competition based on comparison.

This understanding becomes critical in positioning the future of design research. (28)

8.0 Conclusion

Neusearch repositions design research as an independent mode of inquiry, complementary to scientific paradigms but grounded in engagement with reality.

Through the lens of Arupa, the Implicate Order, design may be understood as the articulation of latent order emerging from material, context, and human experience, for a New Society with values based on 'Intelligence and Compassion'.

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