

International Journal on Eternal Wisdom and Contemporary Science



GI4QC Forum's Vision Statement

find something (forgotten or ignored) again by following an alternate path of exploration without letting the current knowledge bias the integrity of the quest

put to use, especially for some practical and relevant purpose

fundamental things that you have to learn first about a subject

cumulative body of know-how, practices and representations (encompassing the complexities of life and nature) developed and maintained by communities with extended histories

Rediscover and apply the elements of Ancient Knowledge Systems to resolve the existing mysteries of science and nature

'solve' implies finding the correct answer whereas 'resolve' means settling or finding a conclusive solution to a problem or a contentious matter

during its astounding journey of understanding how nature works, science encountered some phenomena which could not be explained despite applying all available scientific know-how

use the combined understanding of the ancient and the current knowledge systems with the hope to objectively find evidence-supported explanations to the long-standing and perplexing queries of mankind

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GI4QC Forum's Mission

Conduct innovative cutting-edge experiments to ascertain the potential impact of the observer(s) conscious intent on the observed outcome.

Develop spinoff technologies which enhance the Happiness Index of the individuals as well as the society and are also aligned with the UN Sustainability Goals.

Highlight and publish the credible evidence-based results of the research/study projects.

Make GI4QC Forum the most respected and valued networked association known for unhindered exchange of ideas.



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Aims and Scope: GI4QC Forum is formed with a vision to “Rediscover and apply the elements of Ancient Knowledge Systems to resolve the existing mysteries of science and nature”. The Forum hopes to use the combined understanding of the ancient and the current knowledge systems to objectively find evidence-supported explanations to the long-standing and perplexing queries of mankind, without letting the current knowledge bias the integrity of the quest.

This global platform of professionals is working towards generating innovative solutions that are practical and relevant for holistic development of the society. The Forum aims to disseminate the findings of the integrated approach of research through publication of papers and through organization of conferences, seminars, lectures, etc.

This Journal is an initiative to cater to the above-mentioned objectives. It is a print as well as online open- access peer-reviewed journal which will publish original research papers, review articles, case studies, and perspectives on various topics related to the integration of eternal wisdom and contemporary science from authors across the globe.

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FROM THE EDITOR'S DESK

We are pleased to introduce the third issue of the *International Journal on Eternal Wisdom and Contemporary Science (IJEWCS)*, a peer-reviewed platform that continues to explore the convergence between timeless insights and modern innovation. The present issue showcases eight distinctive contributions that span consciousness studies, traditional yogic wisdom, sacred geometries, and the integration of emerging technologies with civilizational heritage. Collectively, these works signal a rising interest in integrative scholarship—where science, culture, ecology, and spirituality co-evolve.

The lead article, **“A Four-layered Vedantic Framework for Solving the Reverse Hard Problem – Deriving Materiality from Consciousness”**, by Goutam Ghosh, puts forth a transformative framework. Drawing from the *Mandukya Upanishad* and other ancient Indic texts, this paper presents a compelling approach that reverses conventional reductionism and derives materiality from consciousness—a move that repositions Vedantic insights at the frontier of metaphysical and scientific inquiry.

In the same vein of consciousness exploration, in **“From Psychoanalysis to Metacognitive Science: A Triadic Framework for Consciousness and Integrative Inquiry”** Dr. Kaudinya Arpan introduces the *Tri-Pada* framework—a novel synthesis of Freudian dynamics, Indian philosophical triads, and Buddhist epistemology. By bridging introspection and empiricism, this work lays the groundwork for a *spirituo-scientific* paradigm where cognitive inquiry includes the contemplative.

The power of ancient design in landscaping is introduced by Dr. Prabhakar Rao in **“A Case Study on Murugan Mandala Vaatika – The use of Sacred Geometry in Ancient Gardens”**. Here, he shares details of one of his garden projects. These gardens are not just landscapes, they are living mandalas - a confluence of cymatics, sound vibration, geometry, and plant consciousness - inviting aesthetic, sensory, and spiritual activation.

In **“How Today's Technologies Can Recreate and Help Experience the Ancient Knowledge Repositories: A Case Study Research,”** Ajit Padmanabh discusses how tools like 3D scanning, VR, and AR can become mediums to recover and relive the essence of *Itihasa*—history that is lived and remembered. This paper offers a future-facing heritage model, where storytelling, ethics, and policy align with immersive technological potential and help preserve the unique body of knowledge contained our tangible heritage – temples and monuments.

Dr. Sharadchandra Bhalekar contributes a much-needed **“Systematic Analysis of the Practices of *Prāṇāyāma* for Its Effective Adaption and Adoption”**, clarifying the breadth and historical diversity of *Pranayama* across traditional texts. His work emphasizes the need to transcend narrow interpretations and recognize the evolving, practical wisdom embedded in breath-based practices across time.

Dr. Andrew Maclean Pagon explores the concept of *Ojas* and its importance in maintaining life energy, immunity, and vitality in an insightful paper - **“A Systematic Review of the Concept of *Ojas* in *Āyurveda* and Its Parallels in Traditional Medical Systems”**. By integrating traditional medical wisdom with contemporary, conventional science, he throws light on how we can deepen our understanding of holistic health and well-being.

Anita Verma, Sanjay Shete and Dr. Gururaj Doddoli contribute a valuable medical-humanistic perspective through **“The Role of Yoga in Managing Adverse Effects of Cancer Therapies.”** This review highlights yoga's adaptability and efficacy in alleviating physical, psychological, and social distress among cancer patients, suggesting a paradigm of integrative oncology that respects both cellular biology and embodied wisdom.

Finally, Prof. Nixon Patel's “**Perspective: Consciousness and the New Age of Benevolence**” offers a contemplative essay. As we stand at the threshold of a new civilizational ethos, this paper argues for a consciousness-centric worldview capable of ushering in a benevolent future.

As a collective, these articles challenge us to think holistically, to see ancient and modern not as opposites but as partners in a dance toward wisdom. They reflect the journal's ethos: that **eternal wisdom and contemporary science** are not separate domains, but mutually enriching dimensions of the human quest for truth.

We thank our authors and reviewers for their rigorous and insightful contributions. May this issue serve as a beacon for those committed to advancing knowledge rooted in both timelessness and transformation.

Ajit Kumar Verma

Editor-in-Chief

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Reader's Column

Loved the agnostic explanation and interpretations. I feel this should come as a book in a more elaborative way so that it reaches to common audience.

Dr. Kaudinya Arpan on “Bhoutika Shastra To Adi Bhoutika Shastra: A Methodological Exploration Through Quantum Mechanics and Neo-Quantum Physics” by Rameshchandra Ketharaju

A wonderful article by Dr. V Vijaykumar. Linking Enneagram with J.Krishnamurti's thoughts for a better life is totally different from how a common person perceives life in present days. This may look highly philosophical for many but it is the BIG TRUTH that we all must strive to understand and elevate themselves to a higher level of human being with less need, love all, be peaceful and help the society. The same has been very clearly brought out by the author with his life lessons, narrating his personal conflicts within himself and others, how the above reading, understanding, researching has helped him to develop into an individual being happy, content, helping, loving and trying to help the society at large is commendable.

B S Sivanandam (Retired Chief Engineer – Maintenance) on “Integration of Enneagram with J Krishnamurti's Thoughts: An Effective Tool for Personal Growth – A Case Study” by Dr. V. Vijaykumar

Interesting write up by Dr David Frawley on the extremely subtle subject of the Five Pranas and their intimate relationship to the overall health of our bodies. He has researched the subject well and has covered a very abstruse subject in totality. I only wish he had shared the scriptural sources, the texts and the shlokas which gave him such a deep insight. It would have lent a greater authenticity to an otherwise very profound and well written article.

Vinod Tiwari on “The Sanatana Concept of the Five Pranas and its Interrelation with Human Health and Well-being (Svastha)” by Dr. David Frawley (Pandit Vamadeva Shastri)

This effort, even if not original or creative in the academic sense, deserves appreciation. Transparency in presentation is admirable! I hope the authors take their commitment to IKS into bolder studies and writing.

Dr. Rajen Gupta, on “Primacy of Universal-Consciousness: Insights and Revelations from the declassified US Army Stargate Project” by Manish Pajan and Switi Gupta

This is a fantastic piece of work & the author's own biases/views are well blended with the overall explanation of the Enneagram. In my personal view, the Enneagram is a very under-rated technique in a landscape dominated by expensive alternatives which, while catering to an "elite" group of corporates & their leaders, these other tools do not have the potential to scale to very large audiences such as students, non-anglo saxon communities, and so on. Personally, I look forward to reading more insights on the Enneagram & such systems that help the masses. This is also in line with the UN SDG #4, on education.

Venkatesh on “Integration of Enneagram with J Krishnamurti's Thoughts: An Effective Tool for Personal Growth – A Case Study” by Dr. V. Vijaykumar

I offer my heartfelt compliments to the editorial team of the journal for putting together articles on such diverse but very relevant topics on the Ancient Knowledge System. The journal is contributing immensely in taking forward the vision and mission statements that it has laid down. Also my compliments to the authors for their brilliant exposition on Prana in the article “The Sanatana Concept of The Five Pranas and its Interrelationship with Human Health and Well- being”. The section presents profound insights into Prana as the fundamental life force that sustains and animates all living beings. The article draws from both ancient Indic wisdom and contemporary understanding, emphasising Prana's fivefold manifestation (Pancha Pranas) and its vital role in physical, mental, and spiritual well-being. The writing is lucid, well-structured, and deeply rooted in scriptural references, making it both scholarly and accessible. A truly enriching and elevating read that bridges tradition with experiential relevance.

Brig Sunnil Fadatare on “The Sanatana Concept of the Five Pranas and its Interrelation with Human Health and Well-being (Svastha)” by Dr. David Frawley (Pandit Vamadeva Shastri)



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A Four-layered Vedantic Framework for Solving the Reverse Hard Problem - Deriving Materiality from Consciousness

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Abstract:

The ‘hard problem’ of consciousness, i.e., how consciousness emerges from the brain, has not been solved till date. To bridge the gap between materiality and consciousness, philosophers and scientists are delving into deeper layers of reality. This paper addresses the issue from a perspective rooted in *Vedanta* philosophy, which has extensively analysed the deeper layers of reality. *Mandukya Upanishad*, one of the most important texts of *Vedanta* philosophy, describes four states of consciousness, each associated with a distinct layer of reality. *Vedanta* philosophy has thoroughly explored these four layers of reality and their roles in the whole spectrum of creation process, beginning with the Universal Consciousness as the fundamental layer and culminating in the physical world as the fourth and the outermost layer. In this paper, I have presented the ideas related to this four-layered system of reality in a structured and consolidated framework that offers a solution to the reverse ‘hard problem’, i.e., it explains the emergence of materiality from consciousness. The paper also includes a brief comparative analysis of this framework with some popular consciousness theories like those proposed by David Chalmers, Roger Penrose, Stuart Hameroff, Donald Hoffman and Giulio Tononi. Thereafter, I have highlighted the consonance of this layered framework with some significant physical phenomena and laws of nature.

Keywords: Hard problem of consciousness, Consciousness theory, Universal Consciousness, *Vedanta*, *Mandukya Upanishad*, Science and spirituality

1. INTRODUCTION

The main focus of present-day consciousness studies is to explain how the brain processes give rise to our subjective experiences. This problem has been termed as the ‘hard problem’ of consciousness by David Chalmers. In their attempt to solve the ‘hard problem’ of consciousness, some consciousness studies researchers have suggested the existence of more

than one layer of reality. David Chalmers takes conscious experience itself as one of the fundamental features of the world, in addition to mass, charge, etc. Roger Penrose had proposed a third layer to reality – the Platonic world of mathematical forms. He visualized the reality in terms of three worlds - the physical world, the mental world and the Platonic world of mathematical forms. Stuart Hameroff teamed up with Roger Penrose and proposed a theory of consciousness based on quantum gravity effects in the microtubules inside the neurons. This theory adds a new layer to reality; the proto-consciousness. Donald D. Hoffman, on the other hand, takes consciousness to be fundamental. His idea revolves around conscious agents, the dynamics of interacting conscious agents, and how the perception of objects and space-time emerges from such dynamics. Giulio Tononi analysed the essential properties of experience and then developed his Integrated Information Theory. I will discuss these theories in more details in one of the later sections of this paper.

If we look at *Vedanta* philosophy, we find a broader and all-inclusive layered system that has been extensively analysed. *Mandukya Upanishad*, one of the most important texts of *Vedanta* philosophy, describes four states of consciousness and each state is associated with a distinct layer of reality. *Vedanta* philosophy has thoroughly explored all these four layers of reality along with their roles in the whole spectrum of creation process, beginning with the *Brahman* (Universal Consciousness) as the first and the fundamental layer and culminating in the physical world as the fourth and the outermost layer; thus, effectively solving the reverse ‘hard problem’ – the emergence of matter from consciousness. While ‘hard problem’ of consciousness deals with the basic question - how consciousness arises from matter, the term ‘reverse hard problem’ will be used here to deal with the question - how matter arises/emerges from consciousness.

In this paper, which is based on *Mandukya Upanishad*¹, Self-knowledge of Sri Shankaracharya², *Vedānta-sāra* of Sadānanda Yogindra³ and several other related texts (along with some inputs from *Sankhya* philosophy), I have attempted to present the concepts related to this four-layered system of reality in a structured and consolidated way that provides a solution to the reverse ‘hard problem’, i.e., it explains the emergence of materiality from consciousness. Additionally, I have included a brief comparative analysis of select layers and structures of this Vedantic framework in relation to the consciousness theories mentioned above. I have also highlighted the consonance of the layers and structures of the Vedantic framework with some significant physical phenomena and laws of nature and provided suggestions for further research work.

At this point, it is necessary to mention that many *Vedantic* terms (written here in italics) are non-translatable. Their English translations may not convey the inherent ideas fully. For instance, there is a crucial difference in the way the term consciousness is used in *Vedanta* philosophy and in contemporary western theories of consciousness. The term consciousness, as we find in current western theories, is generally associated with the experiences of the mind. But in *Vedanta* philosophy, *chit* - translated as consciousness, has a wider connotation. “In Indian thought consciousness is independent of mind; consciousness exists by itself as a self-

luminous entity.....It is pure ‘contentless’ awareness. It is absolute self-awareness which transcends the senses.”⁴

2. DESCRIPTION OF THE FOUR-LAYERED FRAMEWORK

2.1 The Basic Structure

Figure-1 is an illustration of the four-layered framework that has been conceptualized based on the above mentioned Vedantic texts.

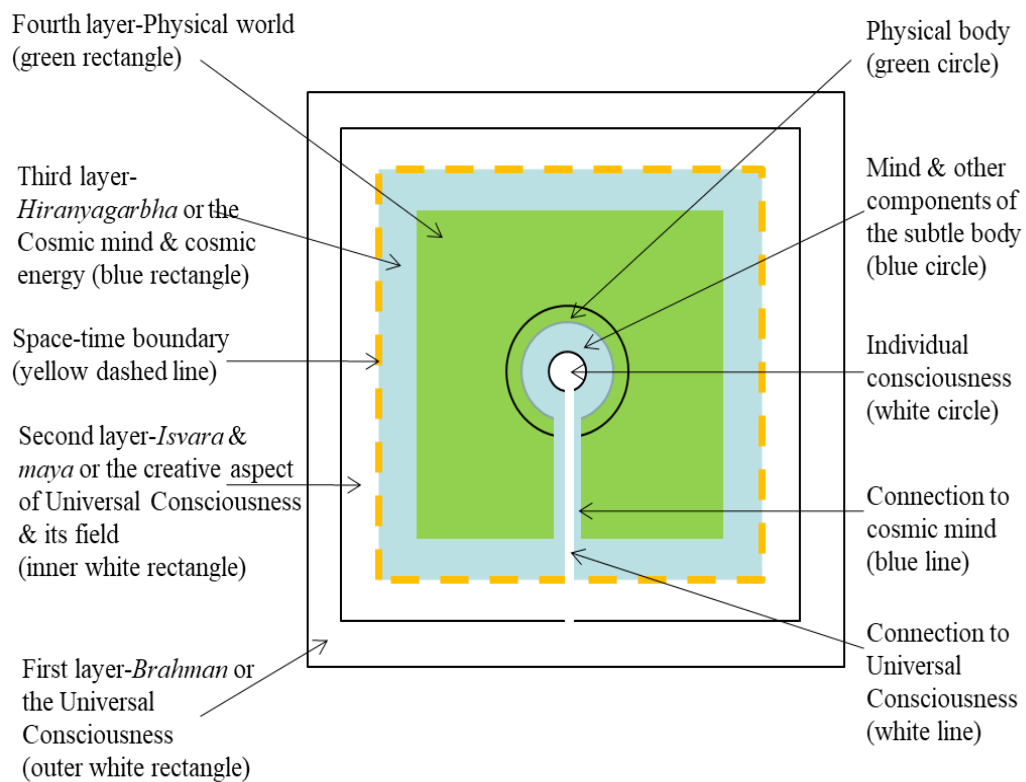


Figure-1: Pictorial representation of the four-layered framework

The rectangular & circular shapes and colours are purely hypothetical. The outermost rectangular layer denotes the fundamental, all-inclusive layer of *Brahman* or the Universal Consciousness that encompasses and permeates all other subsequent layers. Inner to that is the layer of *Isvara* and *Maya*, the creative component of Universal Consciousness and its field. The blue rectangle represents the *Hiranyagarbha* - the cosmic mind and the cosmic energy. The green rectangle represents the physical world. The outer layers permeate all the inner layers. The yellow dashed line represents the space-time boundaries. The circular figures represent *jiva*, the individual living being that has a causal, subtle as well as a gross body. The outer circle represents the gross or the physical body, inner blue circle represents the mind (along with other components of the subtle body) and the white circle represents the individual

The four layers and their components, as viewed through the lens of the manifestation process, have been methodically organized in the following table.

First layer	Second layer			Third layer				Fourth layer		
1	2	3	4	5	6	7	8	9		
Brahman (Universal Consciousness)	Ishvara	Maya	Components of Maya		Tanmatras (5 subtle elements)	Components of tanmatras		Cosmic mind Jiva`s mind & 5 jnanendriyas	Cosmic prana Jiva`s 5 karmenriyas & 5 prana	Physical Universe Jiva`s physical body
			Sattva	Rajas		Sattva	Rajas			
			Tamas	Tamas						

Table 1: The four layers and their components

Table 1 above illustrates the whole process of manifestation in a very concise way. Column 1 represents the *Brahman*. Columns 2, 3 and 4 represents *Isvara*, *Maya* and the three components of *Maya* - *sattva*, *rajas*, and *tamas*. According to Vedantic philosophy creation is the outcome of the continuous interactions of the three components of *Maya* - *sattva*, *rajas* and *tamas*. When *tamas* (of the second layer i.e. column 4) is predominant, the *tanmatras* or the five subtle elements (column 5) are created. These *tanmatras* are the basic ingredients for the third and the fourth layer. The three components (*sattva*, *rajas*, and *tamas*) resurface (column 6) in *tanmatras* and continue their interactions. When *sattva* predominates, it gives rise to individual mind, its five *jnanendriyas* (organs of perception) and the cosmic mind (column 7). When *rajas* is dominant, it leads to the manifestation of the five *karmendriyas* (organs of action) and the five *pranas* (flow of energy regulating the physiological and other subtle processes) of the individual being (*jiva*). The cosmic *prana* (*prana* at the cosmic level) is also manifested at this stage (column 8). The predominance of the *tamas* leads to creation of the gross elements and the physical world of the fourth layer (column 9). The long red arrow in Table 1 illustrates how Universal Consciousness gets limited or reflected in the mind, resulting in the emergence of individual consciousness. These layers and processes will be discussed in detail in the next sections.

Before proceeding further, I would like to clarify the numbering system used by me for the four layers of reality. *Mandukya Upanishad* takes the aspirant, in stages, from waking state to the ultimate state of realization - *Brahman* – and uses the term *Turiya* (fourth) for referring to *Brahman*. However, the objective of this paper is to study the process of manifestation and to

present how Consciousness creates materiality. Therefore, I started from Universal Consciousness (*Brahman*) as the first or the fundamental layer of reality and then numbered the successive layers accordingly.

2.2 The First And The Most Fundamental Layer Of Reality: *Brahman* (Universal Consciousness)

In *Vedanta* philosophy the fundamental layer of reality is *Brahman*. In Vedantic texts we frequently come across the term *sat-chit-ananda* to describe this fundamental reality. *Sat* means existence or beingness, *chit* means consciousness and *ananda* means bliss.

“Pure Being is not an inert material entity lacking self-awareness. It is identical with Pure Consciousness, and is All-Bliss.”⁵

Swami Vivekananda explains all the three aspects very succinctly when he says –

“We are ‘Existence, Knowledge, Bliss’ (*Sachchidânanda*). Existence is the last generalisation in the universe; so we exist, we know it; and bliss is the natural result of existence without alloy.”⁶

Brahman is also the essential substratum of everything, a principle explicitly stated in the opening verse of *Vedānta-sāra* -

“I take refuge in the Self, the Indivisible, the Existence-Consciousness-Bliss Absolute, beyond the reach of words and thought, and the substratum of all, for the attainment of my cherished desire.”⁷

Brahman is described as transcending the limitations of space and time also, embodying omnipresence and eternity. Several references affirm that it exists beyond the spatial and temporal constraints. *Dr. Drshya Viveka* says -

“The entity which is (always) of the same nature and unlimited (by time, space etc.) and which is characterised by Existence-Consciousness-Bliss, is verily *Brahman*.”⁸

According to Swami Vivekananda -

“This Absolute (a) has become the universe (b) by coming through time, space and causation (c).”⁹

The fundamental layer is, therefore, the infinite and eternal substrate with the nature of beingness, consciousness, and bliss. This represents the closest defining characteristics of the fundamental reality within the framework of our conceptual understanding.

It is pertinent to note here that the term Universal Consciousness which is normally used for *Brahman*, may not capture the full meaning in its entirety because it misses the *sat* and *ananda* aspects. However, in the absence of a more suitable term, Universal Consciousness will be used to refer to *Brahman*.

2.3 The Second Layer: *Isvara* And *Maya* (Creative Aspect Of Universal Consciousness & Its Field)

The second layer is the creative aspect of the first layer (see Table 1, column 2 to column 4). The first layer changes into a sense of agency at the universal level – the *Isvara*, with qualities of universal lordship, all controlling power etc.¹⁰ Pure subjectivity changes into a single universal subject with the absolute creative power and is the source or field for the manifested world. This power as well as source is known as *Maya*. As a source of the manifested world, it is also called *Prakriti*¹¹. *Maya* is composed of three components - *sattva*, *rajas* and *tamas* (collectively they are called *gunas*). The creative power of *Maya* expresses itself through these three components. In fact, *Maya*’s etymological meaning is pointer to this aspect -

“That which measures everything (*miyate anaya iti maya*), i.e., that which apparently confines the Infinite Absolute Reality within the limitations of space-time-causation (*desa-kala-nimitta*), and makes It appear manifold, finite, and measurable through the senses and mind, by its three *gunas* of *sattva-rajas-tamas*.”¹²

The three *gunas* are not the qualities of *Maya* but they are its constituents. They are compared to the three strands of the rope of *Maya*. In the unmanifested state, all three *gunas* are in equilibrium. The process of manifestation of world is initiated when this equilibrium gets disturbed by the will of *Isvara* - “.....this equilibrium is disturbed by the will of the lord”¹³, “.....the desire to be many that is in *Isvara* is the seed of creation”¹⁴. From the interactions of the three *gunas*, as explained in next sections, various forms are produced. The predominance of a specific *guna* produces its specific effect on the created form. When *sattva* is predominant, the effect is the creation of knowledge. When *rajas* is prominent the effect is activity and energy. When *tamas* is predominant the effect is inactivity and inertia.

In the words of Swami Vivekananda -

“Nature, before creation, is called by them *Avyakta*, undefined or indiscrete; that is, in which there is no distinction of form or name, a state in which these three materials are held in perfect balance. Then the balance is disturbed, the three materials begin to mingle in various fashions, and the result is the universe. In every man, also, these three materials exist. When the *Sattva* material prevails, knowledge comes; when *Rajas*, activity; and when *Tamas*, darkness, lassitude, idleness and ignorance.”¹⁵

In the words of Swami Prabhavananda -

“In the process of evolution, *sattva* is the essence of the form which has to be realized, *tamas* is the inherent obstacle to its realization, and *rajas* is the power by which the obstacle is removed and the essential form made manifest.”¹⁶

Brajendranath Seal in his book “The Positive Sciences of the Ancient Hindus” has given a very clear description of the *gunas* as follows -

“(1) *Sattva*, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to manifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence; (2) *Rajas*, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work or overcome resistance; and (3) *Tamas*, Mass or Inertia, which counteracts the tendency of *Rajas* to do work, and of *Sattva* to conscious manifestation.”¹⁷

He adds further -

“The *Gunas* are always uniting separating uniting again. Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite and qualitatively determinate.”¹⁸

We can therefore summarise that for any phenomenon to occur or a thing to manifest, *sattva* provides the guiding principle or the intelligence, *rajas* provides the dynamism and energy, *tamas* provides the inertia. In other words, *sattva*, *rajas*, and *tamas* are the foundational aspects that give rise to intelligence, energy, and inertia respectively. It is interesting to note that physics explains the world in terms of energy and matter whereas *Vedanta* philosophy uses the concept of *sattva* in addition to *rajas* (energy) and *tamas* (inertia) to explain the emergence of both the physical world as well as the mental world.

2.4 The Third Layer: *Tanmatras* (The Basic Building Blocks)

Tanmatras or the subtle elements are the basic building blocks of the third and fourth layers. These are the fundamental units of the manifested world and they have been categorized on the basis of those qualities that interact with our senses.

“From the stand of sense-perception there are only five elementary objects in the universe, namely sound, touch, form, taste, smell. That is why *Vedanta* speaks of five elements only.”¹⁹

The subtle elements are named as *shabda*, *sparsha*, *rupa*, *rasa* and *gandha tanmatras*. They are related to the sense of sound, touch, sight, taste and smell respectively and has been named accordingly. *Rupa tanmatra* is associated with the sense of sight which perceives the form as well as the colour. That is why *rupa tanmatra* is occasionally translated as *colour tanmatra*. Brajendranath Seal²⁰ has given a detailed account, based on *Patanjali-Sankhya* system, of how *tanmatras* are created from *Prakriti* (or *Maya*). Based on his explanations, the process of creation of the *tanmatras* has been summarised in Table 2 below.

Stage	Process of creation of <i>tanmatra</i>	Nature of the <i>tanmatra</i>	
		Potential sense stimuli	Potential physical nature
1	2	3	4
1 st	<i>Tamas</i> , acted on by <i>rajas</i> of second layer, generates <i>shabda tanmatra</i>	Sound potential	Vibration potential
2 nd	The vibration potential (column 4), with accretion of <i>tamas</i> and acted on by <i>rajas</i> of the second layer, generates <i>sparsha tanmatra</i>	Touch potential	Impact potential
3 rd	The impact potential (column 4), with accretion of <i>tamas</i> and acted on by <i>rajas</i> , generates <i>rupa tanmatra</i>	Form/colour potential	Light & heat potential
4 th	The light and heat potential (column 4), with accretion of <i>tamas</i> generates <i>rasa tanmatra</i>	Taste potential	Viscous attraction potential
5 th	The taste potential (column 4), with accretion of <i>tamas</i> generates <i>gandha tanmatra</i>	Smell potential	Cohesive attraction potential

Table 2: The process of creation of the *tanmatras*

The term “potential” has been used in column 3 and column 4 because these are not actual sense stimuli or have actual physical nature; their physicality emerges only after certain transformations which I have described in later sections.

2.5 The Third Layer: The Cosmic Aspects - *Hiranyagarbha* (Cosmic Mind And The Cosmic Energy)

The *tanmatras*, as explained in previous section, provide the medium through which cosmic mind and cosmic energies are manifested at this layer. As stated in *Panchikaranam* of Sri Shankaracharya -

“The five unquintuplicated rudimentary elements and their effects, the subtle body, both together constitute what is called the *Hiranyagarbha*.”²¹

The word unquintuplicated (Sanskrit - *apanchikrit*) refers to the *tanmatras* that are in pure form. The details of how these *apanchikrit tanmatras* combine to create the physical world that will be explained in subsequent sections.

We find several references in *Vedanta* that portray the functionality of *Hiranyagarbha* as a cosmic mind or as an outline of the universe. In *Panchadasi*²² (written by Sri Swami Vidyanaraya- a great scholar after Sri Shankaracharya), which is a comprehensive text of *Advaita Vedanta*, we get a distinct indication of this ‘outline’ aspect of *Hiranyagarbha*. The creation process, in this text, has been compared to the four stages of painting of a picture. Each stage corresponds to each layer of the four-layered framework.

- At first, we should have a cloth, a canvas; similarly, for creation to proceed, we have an unchanging background - the *Brahman*.
- The canvas would have to be straightened or stretched; similarly, the *Brahman* – the unchanging background - gets stiffened and we have, in the second stage, the creative will of *Isvara*.
- In the third stage, the artist draws an outline of the painting on the canvas. Similarly, in the act of creation, the cosmic mind or the *Hiranyagarbha* is the cosmic outline of the universe that helps manifest the universe.
- In the fourth stage, the lines are filled with colour and we have the final painting. Similarly, the universe is created with all the diversity, colour and splendour.

Swami Vivekananda has very beautifully explained the concept of a cosmic ideation preceding the physical universe. He says -

“In the universe, *Brahma* or *Hiranyagarbha* or the cosmic *Mahat* first manifested himself as name, then as form, i.e., as this universe. All this expressed sensible universe is the form, behind which stands the eternal inexpressible *Sphota*, the manifest as Logos or Word. This eternal *Sphota*, the essential eternal material of all ideas or names, is the power through which the Lord creates the universe, nay, the Lord first becomes conditioned as the *Sphota*, and then evolves Himself out as the yet more concrete sensible universe. This *Sphota* has one word as its only possible symbol, and this is the *Om*.”²³

By the word *Sphota* he is specifying *Isvara*’s cosmic ideation.

The concept of *Hiranyagarbha* is also associated with the cosmic energy needed to create the physical world. In *Brahmasutra*²⁴, *Hiranyagarbha* has been referred to as the Cosmic *Prana*. *Prashna Upanishad*²⁵ states that the sum total of all *Pranas* (energies) is called *Hiranyagarbha*. In the explanations given in *Aitrei Upanishad*²⁶, *Hiranyagarbha* has been specified as cosmic power of knowledge and action implying the cosmic mind and cosmic energy respectively. This *Prana*, according to Swami Vivekananda²⁷, is manifesting as different forms of energy and forces in the physical as well as in the mental world.

Hence, at the third layer, the macro level structure of *Hiranyagarbha* incorporates both the cosmic mind (the cosmic ideation) and the cosmic energy (Cosmic *Prana*) needed to create the physical world. The *sattva* and *rajas* components of *tanmatras* seem to play their respective roles in shaping these two aspects of *Hiranyagarbha*.

It is also important to note here that the manifestation of space, time & causation begins from the third layer. The *Maya* of the second layer is characterized as that which restricts the fundamental reality within the boundaries of space, time & causation and it is from the third layer - the layer of *Hiranyagarbha* - that the influence of space, time & causation appears to originate. “.....the *Hiranyagarbha* state when relativity in the form of space-time-causation just begins to sprout.....”²⁸

2.6 The Third Layer: The Individual Aspects - *Antahkarana* (Mind) And Other Components Of *Jiva*'s Subtle Body

The preceding section explored the cosmic dimensions of the third layer, while this section delves into the individual (*jiva*) aspects. Vedantic texts like Self-knowledge of Sri Shankaracharya and *Vedānta-sāra* of Sadānanda, have very clearly mentioned the process of creation of subtle body of *jiva* consisting of mind (*antahkarana* having *buddhi*, *chitta*, *manas* & *ahamkara*), five organs of perception, five organs of action and five *pranas*. Their process of creation has been briefly depicted in Table 3.

Parts of <i>jiva</i> 's subtle body	Created from
1	2
<i>Buddhi</i> (intellect) including <i>chitta</i> (memory)	<i>Sattva</i> components of five <i>tanmatras</i>
<i>Manas</i> (deliberative mode of the mind) including <i>ahamkara</i> (egoism)	
Five <i>jnanendriyas</i> (organs of perception)	
Five <i>karmendriyas</i> (organs of action)	<i>Rajas</i> components of five <i>tanmatras</i>
Five <i>pranas</i> (flow of energy regulating the physiological and other subtle processes)	

Table 3: Parts of *jiva*'s subtle body

The five organs of perception and the five organs of action are not the physical organs but they are the parts of the subtle body and functions through the physical organs. The five organs of perception are the ears, the skin, the eyes, the tongue, and the nose. The five organs of action are the organ of speech, the hands, the feet, and the organs of evacuation and generation.

It would be pertinent here to also explore the process of emergence of individual consciousness. There are two aspects or powers of *Maya* - the power of projection (*viksepa sakti*) and the power of veiling (*avarana sakti*)²⁹. The two powers function side by side. The power of projection creates the third and the fourth layers, as explained previously, through the interactions of the three *gunas* - *sattva*, *rajas* and *tamas*. The veiling power of *Maya* is responsible for the creation of a sense of agency or the individual consciousness at the microcosmic level. Explanatory texts on Self-knowledge of Sri Shankaracharya mentions “*Brahman*, or Pure Consciousness, associated with individual ignorance, is called the *jiva*, or individual living soul. The *jiva* dwells in a body”³⁰ The Universal Consciousness appears to get limited or reflected in the subtlest part of the mind resulting in the emergence of individual consciousness as a living being or the *jiva*.³¹ The long red arrow in Table 1 illustrates this association. The *jiva* is endowed with the powers of knowledge, will and activity.³²

2.7 The Fourth Layer: Physical World

This section will delve into the last stage of the four-layered framework - the creation of the physical world. *Tanmatras* have a central role in creation of materiality. In this four-layered framework, the origination of materiality happens in three stages. The process starts from *Maya* or *Prakriti* of the second layer, goes through third layer of *tanmatras* and finally manifests as gross elements and the universe in the fourth layer. The Self-knowledge of Sri Shankaracharya³³, *Vedānta-sāra* of Sadānanda Yogindra³⁴ and many other texts have given a detail description about these processes which is summarized in table 4.

Second layer: <i>Maya</i> or <i>Prakriti</i>	Third layer: <i>Tanmatra</i>	Fourth layer: Gross elements
1	2	3
When the three components of <i>Maya</i> (<i>sattva</i> , <i>rajas</i> , <i>tamas</i>) are in disequilibrium state, with <i>tamas</i> being prominent, <i>tanmatras</i> of the third layer are created.	The three components of <i>tanmatras</i> (<i>sattva</i> , <i>rajas</i> , <i>tamas</i>) interact and with <i>tamas</i> being prominent, gross elements of the fourth layer are created.	From gross elements, the universe is created.

Table 4: Deriving Materiality from Consciousness

As mentioned in section 2.5, the overall process of creation of the physical world of the fourth layer is guided by the cosmic ideation of the third layer, i.e., the layer of the *Hiranyagarbha*. The origination of materiality, as mentioned in the *Patanjali-Sankhya* system, has been analysed exhaustively by Brajendranath Seal. He says -

“Three stages clearly stand out in the genesis of Matter:- (1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium come to an end (*Bhutadi*) (2) the infra-atomic unit-potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass (*Tanmatra*); and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex *Tanmatric* systems (*Sthulbhutaparamanu*).”³⁵

The actual creation process of the five gross elements and the universe, has been explained in detail by Seal³⁶. The five subtle elements evolve into five *bhutas* or gross elements - *akasha*, *vayu*, *tejas*, *ap*, *prthivi*. Additionally, the sequence of creation of gross elements aligns with the stages of creation of the universe as specified in modern cosmology. The detail process is as follows

- The first *tanmatra* - the *shabda tanmatra* or “the vibration potential” gets more accretion of *tamas* and generates the first physical element - *akasha bhuta* (equivalent to physical space) which is “...ubiquitous and all-enveloping”.
- The *shabda tanmatra* or the “vibration potential” combines with the *sparsha tanmatra* or the “impact potential” and the second physical element the *vayu* (gaseous state) is created. This element “...by aggregation formed a gaseous envelop”.
- The first three *tanmatric* energies (*shabda*, *sparsha* and *rupa*) then add up and we get the *tejas* (fire) element “...which by aggregation enveloped the gaseous world in huge flames”.
- In the fourth stage, the first four *tanmatric* energies (*shabda*, *sparsha*, *rupa* and *rasa*) add up and we get the *ap* (fluid) element. “The flaming gases were precipitated into cosmic masses of viscous fluid matters”.
- Finally, all the five *tanmatric* energies add up we have the solidification of the fluid state. It is the state represented by *prthivi* (earth-solid). “Thus the viscous fluid matters were condensed and transformed into the Earth-Bhuta....”

It may be mentioned that that these *bhutas* are not the elements of chemistry but they “.....stand for a classification of substances on the basis of their generic properties..... a classification more physical than chemical...”³⁷ A particular *bhuta* class may have different chemical elements due to different combinations of *sattva*, *rajas* and *tamas* in them.³⁸

The *tanmatras*, corresponding *bhutas* (gross elements) and the stages of evolution of the universe are summarized in table 5.

Name of the <i>tanmatra</i> (subtle element)	Nature of the <i>tanmatra</i>		Corresponding <i>bhuta</i> class (gross element) created	Stages of evolution of the universe
	Potential sense stimuli	Potential physical nature		
1	2	3	4	5
<i>Shabda tanmatra</i>	Sound	Vibration	<i>Akasha</i> (space)	“...ubiquitous and all-enveloping” medium
<i>Sparsha tanmatra</i>	Touch	Impact or mechanical pressure	<i>Vayu</i> (gaseous state)	“...by aggregation formed a gaseous envelop”
<i>Rupa tanmatra</i>	Form/colour	Heat and light	<i>Tejas</i> (fire)	“...which by aggregation enveloped the gaseous world in huge flames”.
<i>Rasa tanmatra</i>	Taste	Viscous attraction/ liquidity	<i>Ap</i> (liquid/fluid)	“The flaming gases were thus precipitated into cosmic masses of viscous fluid matters”
<i>Gandha tanmatra</i>	Smell	Cohesive attraction/ hardness/ solidity	<i>Prthivi</i> (earth/solid)	“...the viscous fluid matters were condensed and transformed into the <i>Earth-bhuta</i> ”

Table 5: *Tanmatras*, *Bhutas* and the stages of evolution of the universe

However, there is a different view, as mentioned by Sri Shankaracharya and explained in detail by Sri Suresvaracharya³⁹, regarding the actual creation process of gross elements from subtle elements. It is the *panchikarana* (quintuplication) process. The equation for this transformation process is as follows-

Gross element 1 = $\frac{1}{2}$ (subtle element 1) + $\frac{1}{8}$ (subtle element 2 + subtle element 3 + subtle element 4 + subtle element 5)

This equation has been generalized from the equations described by Swami Satprakashananda in his book “The Universe, God, and God-Realization”.⁴⁰

It is worth noting here that *Vedanta* offers very useful insights into the connection between space and materiality. The equilibrium state of *Maya* (the second layer) is beyond the web of

space or time. After the equilibrium is broken, *rajas* working on *tamas* gives rise to the vibrational *tanmatra* of the third layer, and this *tanmatra*, with further accretion of *tamas*, creates the first gross element – *akasha* or the space. The concept of space emerges from the first subtle element or the vibration *tanmatra*. *Akasha* or space has vibration as its genesis; hence it is a dynamic quantity and gets its sustenance of materiality from *tamas*. It is the first evolve in the cosmic evolution and as described earlier, materiality of the grosser forms evolves from it.

2.8 Putting It All Together In The Form Of Postulates

This section consolidates the descriptions of the four-layered framework, presenting them systematically in five distinct postulates.

- | | |
|-------------|---|
| Postulate 1 | <i>Brahman</i> or the Universal Consciousness is the first and the fundamental layer which is all-pervasive and eternal. |
| Postulate 2 | The second layer represents the creative aspect of the first layer. The first layer changes into a sense of agency at the universal level and its associated field – the <i>Isvara</i> and <i>Maya</i> . <i>Maya</i> consists of three components – <i>sattva</i> , <i>rajas</i> and <i>tamas</i> (foundational aspects of intelligence, energy and inertia). Additionally, <i>Maya</i> possesses both the projection and veiling powers. |
| Postulate 3 | The interactions of the three components, with <i>tamas</i> taking precedence, results in the formation of the five subtle elements which serve as the foundational building blocks for the third and the fourth layers. The three components reemerge within the subtle elements and continue to interact with one another. When the <i>sattva</i> dominates, the cosmic mind (a blueprint or the ideation for the universe) and individual minds are formed. When the <i>rajas</i> takes precedence, cosmic energy and individual vital energies come into existence. |
| Postulate 4 | When <i>tamas</i> components of the five subtle elements dominate, the physical world and the individual physical bodies of the fourth layer are formed, guided by the cosmic ideation of the third layer. All these manifestations arise from the projecting power of <i>Maya</i> . |
| Postulate 5 | The veiling power of <i>Maya</i> veils the Universal Consciousness which gets limited in the subtlest part of the individual's mind and appears as individual consciousness. This gives the impression of individual consciousness being generated and being confined within the mind/brain of a living being. |

3. APPLICATIONS OF THIS FOUR-LAYERED FRAMEWORK

The four-layered framework described in previous sections will now be applied in to examine three questions – First, I will show how this framework provides a solution to the reverse ‘hard problem’. Next, I will do a brief comparative analysis of this framework with some popular consciousness theories like those proposed by David Chalmers, Roger Penrose, Stuart Hameroff, Donald Hoffman and Giulio Tononi. Finally, I will discuss the consonance of the layers & structures of this framework with some of the significant physical phenomena and laws of nature.

3.1 Solution To The Reverse ‘Hard Problem’

The ‘hard problem’ of consciousness deals with the basic question - how consciousness arises from matter. This has been the key focus of the Consciousness Studies. However, it has not been solved till date. In this paper I reversed the ‘hard problem’ and started with the premise that we cannot deduce consciousness from materiality; rather materiality evolves from consciousness. I presented a four-layered Vedantic framework as a solution to this reverse ‘hard problem’. In the previous sections, I have described this framework which starts from Universal Consciousness at the fundamental level and then, in stages, evolves to create cosmic mind, individual mind, individual consciousness and the physical world, thus providing a solution to the reverse ‘hard problem’ - Deriving Materiality from Consciousness.

3.2 A Brief Discussion On Some Of The Popular Consciousness Theories In The Light Of The Four-Layered Framework

3.2.1 David Chalmers’ ‘Conscious Experience’ As A Fundamental Feature Of The World

According to David Chalmers (1995)⁴¹, ‘conscious experience’ cannot be explained in terms of the physical. He takes the experience itself as one of the fundamental features of the world in addition to mass, charge, etc.

According to the four-layered framework, the subtle body, which includes the mind (seat of experience) belongs to the third layer while the physical world belongs to the fourth layer. This framework does not consider them to be the fundamental features of reality. Instead, these layers evolve from *Brahman* - the fundamental layer of reality

3.2.2 Roger Penrose’s Three Worlds

Roger Penrose, in his book “Shadows of the mind”⁴² visualized the reality in terms of three worlds - the Platonic mathematical world, the physical world and the mental world. The

three worlds of Penrose may be redrawn, leaving out the details, in a very simplified way as depicted in figure 2.

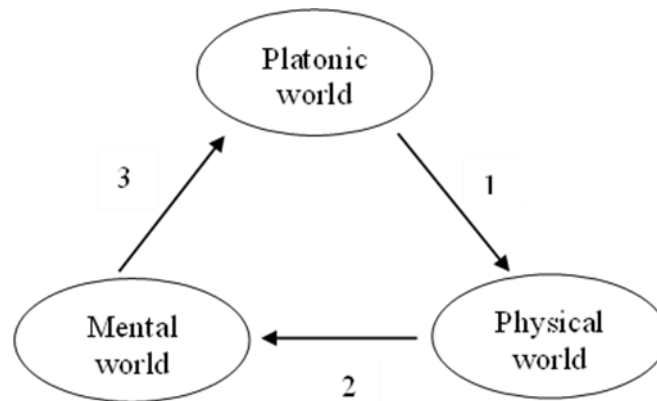


Figure 2: The three worlds

Penrose says that there are three mysteries in the three respective connections between them. The first mystery is that the world of physical reality seems to emerge out of the Platonic world of mathematics. The second mystery is how “perceiving beings” with its mental world come out of the physical world and the third and final mystery is as to how our minds access the Platonic mathematical world.

An attempt can be made for solving these mysteries based on the four-layered framework. If the first and second layers are removed from figure 1, then the remaining layers and components become equivalent to the three worlds of Penrose. The Platonic world will be equivalent to the cosmic mind of the third layer, the mental world is equivalent to the individual mind of the same layer and the term physical world is the same in both the frameworks. However, the arrangements of the three worlds of Penrose gets changed. It is illustrated in figure 3 below.

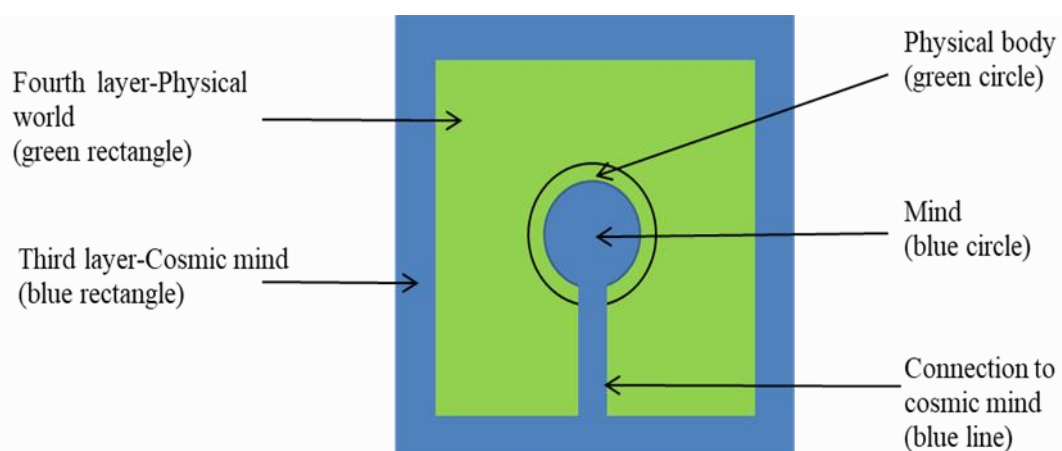


Figure 3: Equivalent layers of four-layered model and Penrose's three worlds

The first mystery can be solved if we consider the point (explained in section 2.5) that the fourth layer do emerge out according to the cosmic ideation of the third layer. Repeating the quote of Swami Vivekananda again..... “In the universe, Brahma or *Hiranyagarbha* or the cosmic Mahat first manifested himself as name, then as form, i.e., as this universe....”. Regarding the second mystery, it is not that the “perceiving beings” with its mental world come out of the physical world, it is the *jiva*’s subtle body that develops its gross body⁴³. The third and final mystery of how our minds access the Platonic mathematical can be solved simply if we accept the premise that the individual mind is a part of the cosmic mind and consequently it can access the cosmic mind.

3.2.3 Penrose-Hameroff ‘Orch OR’ Theory Of Consciousness

According to this theory⁴⁴, the quantum mechanical effects in the microtubule structures inside the neuron are linked with the fluctuations of the corresponding space-time geometry. Further, proto-consciousness “lacking cognition & meaningful content” are supposed to exist at the Planck scale space time geometry. Orchestrated Objective Reduction (Orch OR) of the quantum state converts the proto-consciousness into a “stream of consciousness”. In the four-layered framework, *Maya* “measures” (refer to section 2.3) or apparently confines the Universal Consciousness within the limitations of space, time and causation, creating the individual consciousness. The Orch-OR process, it seems, may represent some similarities with the processes of *Maya*. However, there is a basic difference between these two processes. Orch OR model creates the stream of consciousness from proto-consciousness in a bottom-up approach where as in the four-layered framework, it is a top-down process. Universal-Consciousness, which is eternal, infinite and complete in itself, gets limited by *Maya* and from that limitation, individual consciousness emerges.

3.2.4 Donald Hoffman’s Conscious Agent

In Hoffman’s theory⁴⁵ as well as in the four-layered framework presented here, consciousness is fundamental and matter is derivative. Hoffman’s conscious agent has three processes - perception, decision and action. Similarly, the *jiva* (an embodied individual consciousness) is endowed with the powers of knowledge, will and activity (section 2.6).

In Hoffman’s theory, there are different types of conscious agents starting from the experiencing conscious agents to the experience creating conscious agents. In the four-layered framework, however, there are *jivas* as the experiencing conscious agents and different forms that are experienced by the *jivas*. The psycho-physical structure of a *jiva* as well as the different forms that are experienced by the *jiva*- both are created from the interactions of *sattva*, *rajas* and *tamas* of the *tanmatras*.

There is another aspect in Hoffman’s theory which is very similar to what Swami Vivekananda has stated about the process of perception. Although I have kept the process of perception out of scope of discussion in this paper, I believe that it is important to mention it in this context. In Hoffman’s theory, objects that are experienced by a conscious agent are

just icons in its perceptual interface and not the actual things. Swami Vivekananda says “Take this book; as a book it does not exist outside, what exists outside is unknown and unknowable. The unknowable furnishes the suggestion that gives a blow to the mind, and the mind gives out the reaction in the form of a book”⁴⁶

3.2.5 Giulio Tononi’s Integrated Information Theory

Tononi’s Integrated Information Theory⁴⁷ also begins with consciousness/experience as its foundation, though it approaches the subject in a different manner. The theory tries to identify the essential features of consciousness as axioms then postulates about the properties a physical system must contain so as to account for those features. It then uses those postulates to find out whether a system has consciousness.

The two features of Integrated Information Theory and the four-layered framework that are similar are shared below.

The first axiom of Integrated Information Theory states “Consciousness exists”. It closely resembles the first two aspects of *Brahman* or Universal Consciousness i.e. *sat* and *chit* as explained in section 2.2. Universal Consciousness exists and is self-aware.

Further, Integrated Information Theory defines a cause-effect space and says “.....an experience is a ‘form’ in cause-effect space”. Tononi’s above concept very closely resembles what Swami Vivekananda had stated (section 2.5), “In the universe, *Brahma* or *Hiranyagarbha* or the cosmic *Mahat* first manifested himself as name, then as form, i.e., as this universe”. In the four-layered framework, the cosmic mind or the *Hiranyagarbha* of the third layer, described in section 2.5, serves as the blueprint or the cosmic ideation of the universe. Various forms in the physical universe manifest based on this cosmic ideation.

3.3 Consonance With Various Physical Phenomena & The Laws Of Nature And Suggestions For Further Research

The four-layered framework’s consonance with various physical phenomena and the laws of nature will now be briefly outlined. Further research is needed in these areas so that more clarity may be obtained.

3.3.1 A Theory Uniting Subjectivity And Objectivity

Attempts are being made for a unified theory involving all types of matter and forces. But for a truly unified theory, we also have to unite (in addition to matter and forces) the mind as well as consciousness into a single system. As mentioned by Stephen Hawking, in his book ‘A brief history of time’⁴⁸, “A complete, consistent, unified theory is only the first step: our goal is a complete *understanding* of the events around us as, and of our own existence”. *Brahman* or the Universal Consciousness is that fundamental reality, a unifying ground, from which mentality as well as materiality emerge.

3.3.2 *Rajas & Tamas: Dark Energy, Dark Matter?*

In sections 2.4 and 2.7 it was stated that *rajas* working on *tamas* of the second layer gives rise to the vibrational *tanmatra* (*shabda tanmatra*) of the third layer, and this *tanmatra*, with further accretion of *tamas* creates the first gross element - *akasha* or the space. It gets its sustenance of materiality from *tamas*. From *akasha* or space, materiality of grosser forms evolves. Hence *tamas* may have some correspondences with the concept of dark matter which provides the missing mass of the universe. Dark energy, on the other hand is responsible for universe's accelerating expansion. It resembles the *rajas* which incessantly provides the dynamism required for the creation of the third and the fourth layer.

3.3.3 *Rajas & Tamas: Similarities With String Vibrations*

In string theory, the basic building blocks are the one-dimensional vibrating strings of highly concentrated mass-energy which vibrate like the strings of a musical instrument and each vibrational mode generates a particle. In the four-layered framework, a similar process has been described. *Rajas* (energy) and *tamas* (inertia) along with *sattva* (medium for reflection of intelligence) vibrate and interact among themselves that creates the *tanmatras*, cosmic and individual mind, physical world etc.

3.3.4 *Tanmatras: Quantum Fields?*

The quantum fields may have some correlations with the *tanmatras* of the third layer of the four-layered framework. Both describe the fundamental, subtle realities underlying the manifest world. Both undergo certain excitations or vibrations after which materiality is manifested.

3.3.5 *Sequence Of Creation Of Gross Elements And Its Similarities With Modern Cosmology*

The sequence of creation of gross elements matches the process of evolution of the universe as described by modern cosmology. The process of creation (section 2.7) unfolds in the following manner. Initially there is the vibration (represented by *akasha bhuta*) which is "...ubiquitous and all enveloping" medium. The vibration causes friction or impact (represented by *vayu bhuta*) which "...by aggregation formed a gaseous envelop". The friction or impact gives rise to heat & light (represented by *tejas bhuta*) "...which by aggregation enveloped the gaseous world in huge flames". The heat and light cools down & we have liquefaction and get the fluid matter (*Ap bhuta*); "The flaming gases were thus precipitated into cosmic masses of viscous fluid matters". Finally, we have the solidification of the fluid state (*prthivi bhuta*) "...the viscous fluid matters were thus condensed and transformed into earth *bhuta*".

3.3.6 *Relation Of Space & Cosmic Ideation*

It is the third layer where we see the simultaneous emergence of space (through *shabda tanmatra* and then *akasha*) as well as the cosmic ideation or the blueprint for the universe.

This phenomenon suggests that the code for evolution of universe may have been embedded in the fabric of space in some hidden dimensions.

3.3.7 Parallels Between The Measurement Processes In Quantum Mechanics And Vedanta

In quantum mechanics, measurement causes the collapse of the wave function, leading to the emergence of finiteness. In *Vedanta* philosophy we find several instances where it is stated that measurement of infinite or undifferentiated causes finiteness to appear. The etymological meaning of *maya* (section 2.3), is closely associated with the process of measurement.

“That which measures everything (*miyate Anaya iti maya*), i.e., that which apparently confines the infinite absolute Reality within the limitations of space-time-causation (*desa-kala-nimitta*), and makes It appear manifold, finite, and measurable through the senses and mind, by its three *gunas* of *sattva-rajās-tamas*”

The process of measurement has also been mentioned in the 11th mantra of the *Mandukya Upanishad*.

“*Prajna* with the sphere of activity in sleep state is m, the third letter of Om, because of measuring or because of absorption.....”⁴⁹

According to *Mandukya Upanishad*, *prajna* is the deep sleep state, purely undifferentiated. This state is the doorway to the discrete experiences of the *taijasa* or the dream state and the *visva* or the waking state. It is, as if, dream and waking states are measured out by a measuring vessel from the undifferentiated sleep state.

3.3.8 Debating The Possibility Of Machine Consciousness

The debate over whether consciousness can emerge from machines having artificial intelligence can be placed in proper perspective if we base our arguments on figure 1 and associated descriptions. Individual consciousness, as has been depicted in figure 1, is not an isolated one. It is deeply connected to the Universal Consciousness that transcends the boundaries of space and time and exists in a non-dual realm. An AI system that exists in a physical hardware situated within the boundaries of the physical world cannot access or capture the non-dual, unchanging, non-algorithmic and non-computational realm of consciousness. AI systems may be able to simulate the behavioural aspects of consciousness but it will not be able to become conscious merely on the basis of algorithms and computational processes.

4. CONCLUSION

This four-layered framework provides a broad and holistic perspective on reality, rooted in Vedantic philosophy, and presents a solution to the reverse hard problem. The first and the second layers of this four-layered framework cannot be experimentally verified; their essence has been realized by the *rishis* in their profound states of meditation. However, if these initial layers are accepted as it is, the subsequent layers and structures unfold logically and sequentially. Some of its layers and structures have comparable features with those of several prominent consciousness theories. Moreover, the outer layers of this framework align with some key physical phenomena and natural laws, providing meaningful insights into their nature. This attribute makes the framework an ideal platform for the convergence of spiritual and scientific domains.

Brief Profile of the Author:

Goutam Ghosh did his Master's in Physics and then completed a PG Diploma in Computer Applications. He taught Physics for a few years and later joined the Planning & Development Department, Govt. of Bihar, and looked after the IT operations for the department. His interest in Consciousness Studies, which was initiated during his university days, continued simultaneously and to gain an experiential insight, he completed a PG Diploma in Yogic Studies. After working for 24 years in the Planning & Development Department, he took early retirement and followed his passion for Consciousness Studies as an Independent Researcher.

He has been presenting his views on Consciousness in various Conferences and Forums. Some notable among them were - "Models of Brain & Mind" Conference by the Saha Institute of Nuclear Physics, Kolkata (2006); "World Congress on Psychology & Spirituality" Conference organized by the Association for Transpersonal Psychology & other groups in Delhi (2008); "Science of Consciousness" Online Conference organized by the Centre for Consciousness Studies, University of Arizona (2020); Conference on "Machine, Mind and Consciousness" organized by the Bhaktivedanta Institute in Bengaluru (2024), etc. He is associated with several groups who are working on the diverse areas of Consciousness Studies and on advancement of Indian Knowledge Systems. He is based in Bengaluru.

Statements and Declaration: This paper is an extension of the ideas and concepts presented by the author at various conferences and forums. The author declares he has no conflict of interest with anybody in publishing this paper. No financial support was received for the work within this paper.

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How Today's Technologies Can Recreate and Help Experience the Ancient Knowledge Repositories: A Case Study Research

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Abstract:

Indian Knowledge Systems (IKS) are timeless as evidenced by each of us, the living descendants of this multi-millennia civilizational ethos. Some of the nuggets of knowledge from millennia ago still guide us in our day-to-day activities or even with our health and wealth management techniques. The knowledge is both deep and vast and as cliched as it may sound, multi-dimensional in its construct. One of the dimensions has to do with the unique body of knowledge with regards to our tangible heritage – temples and monuments. This paper focuses on aligning modern technologies to document and retell the grandeur of those ancient knowledge repositories. We look at emerging technologies like 3D Scanning, VR, AR, 3D Printing to reconstruct our glorious past and retell the History the way it happened (*Itihaasa*). It also provides a critical view of the need for policy building so as to ensure the technology and associated storytelling is beneficial to everyone.

Keywords: Virtual Reality (VR), Augmented Reality (AR), Ancient Monuments, Archaeoacoustics, HeriTech

INTRODUCTION

(For the benefit of the readers, definitions of key terms have been provided at the end of the paper)

Temples are not only marvels of art and architecture but also the embodiments of ancient technologies and a window into our ancestors' ways of working, their tools and their skills. The modern world is yet to understand and appreciate in its entirety the magnificence of these wonders and the depth of knowledge manifested through them. This paper looks at leveraging modern technologies to recreate and experience these ancient knowledge repositories, tools and techniques. Imagine visiting a temple in Virtual Reality (VR) or Augmented Reality (AR), replete with multi-sensory technologies like haptics, olfactory and gustatory devices. This could be leveraged for tourism-discovery on various portals (VR, AR and Web) thereby enhancing

the global marketing of our ancient wonders and reclaiming the *Vishwaguru* title, as well as amplifying tourism revenues for our country. As a part of recreating the temples, there is a need to leverage technologies like 3D Scanning and 3D Modeling. These, in turn, help in preservation of our temples for posterity, storing information of entire temple complexes. Using 3D scanners like FARO Focus Premium 70, a resolution of 0.1mm can be achieved, making the documentation of intricate details of the monument possible. In the event of any damage or destruction, the area can be referred to, in the 3D model, and restored to its erstwhile glory.

Owing to a millennium of invasions in India, a lot of ancient knowledge has been lost. This should serve as a warning to help safeguard and preserve whatever sources of ancient knowledge we have today. Authentic sources pertaining to ancient temple architecture and associated sciences are far and few and for some temples, extinct. Given this situation, it is imperative on us to leverage today's ground-breaking technologies like VR, AR, AI, Blockchain and Quantum Computing to recreate the authentic past in terms of monuments, culture, jewelry, costumes etc. This paper would focus on VR and AR usage in bringing back the monuments to life and touch upon the usability of AI and Blockchain in this endeavour.

Our paper will focus on Temple Architecture, Engineering & Sciences and the role of modern technology in preserving the knowledge for posterity. We will also focus on a couple of challenges viz. Adoption of Technology, the role of Subject Matter Experts and *Sthapathis*.

SCOPE

Renowned *Vishwakarmā* K.P. Umapathy Acharya states that “it is more important to study the spirit of the ancients through their temple architecture and *Vedic* studies than to analyse their ‘*means of construction*’. Indian architecture will never be a mere construction, it is an inspiration, prophecy and revelation of spirit.”¹ Every aspect of temple construction has deep significance and spirituality.

With today's immersive and emergent technologies, it is possible to recreate the entire space in 3D, step by step, thereby recreating the temple architecture and engineering. To add to it, we can enable everyone to experience temples as they used to be in the past, in all its glory. This includes the sights and sounds, costumes, jewelry and the day-to-day happenings in and around temple premises. We must remember that temples were not merely places of worship but were lively cultural centres.

Our endeavour, through this paper, would be to understand “Ancient Temple Architecture and Engineering Design” and “Ancient Sciences” as employed by our ancestors during the development of these magnificent structures. We are also going to focus on how “Modern Technologies can Recreate the Past”.

Ancient Temple Architecture and Engineering Design

Āgamashāstra and *Sthāpathyaveda* have within them every aspect of temple design and construction. For example, they include the science behind designating a certain location within a site to host the outer walls of the temple or to select the cardinal directions of a site based on day-dusk shadows². Such depth of knowledge had been transferred from generation to generation and has lasted for millennia. However, this knowledge is at risk of being lost to modern, lucrative professions owing to decline in traditional roles and practices like *Sthāpatya*, *Vishwakarmā* etc. Hence, there is an urgent need to store all aspects of this ancient knowledge, meticulously and authentically. In this paper we are exploring how we can embrace modern technologies to achieve the same.

E-learning modules related to *Āgamashāstra* and *Sthāpathyaveda* with Augmented Reality technology can really transform the teaching paradigm for these ancient sciences. India is the largest consumer of Mobile devices like phones and tablets, across rural and urban India. This makes it a viable medium for us to teach these ancient sciences to a wider audience, either as single-player modules or multi-player modules. The rules of *Āgamashāstra* and *Sthāpathyaveda* can be gamified and looked at, in terms of codified rules within the software, allowing or disallowing certain constructs within the temple construction. This would help the student learn quickly and visually the dos and don'ts of the ancient sciences through an immersive visual media.

Ancient Sciences

There is a need for scientific research into various aspects of Indic Heritage like astrology, astronomy, neurosciences, music etc. When these researches are showcased as visual and aural experiences, it is bound to evince interest in young minds to take to research and contribute to our heritage.

Today's documentaries and short videos or memes have the potential to instil a sense of pride in our ancestors' knowledge but they do not help in its retention in the consumer's memory for application in future. As an example, alignment of the Nataraja Temple at Chidambaram with the Orion Constellation during the *Ardra* festival (*Ardra Nakshatra* is the Betelgeuse of the Orion) establishes the connection between temple architecture and ancient astronomy as well as astrology³. It also highlights our ancients' observations of star movements to create detailed star maps which were utilized in various aspects of life like agriculture, besides temple construction.

The date of every festival is determined by the *panchāṅg* which requires sophisticated knowledge of ancient astrology and astronomy. This is but one aspect of our ancient knowledge that needs to be brought out leveraging modern visual technologies for powerful and retentive education and storytelling. Many other aspects like *Vedapāṭha* and their impact on human brain needs to be deeply researched by neuroscientists and become a part of the overall immersive experiences. Neuroscientist James Hartzell researched about this very concept and termed it "The Sanskrit Effect"⁴.

Modern Technologies can Recreate the Past

Visual Technologies like VR, AR, 3D Scanning, 3D Printing and AI have greatly developed over the last two decades. We have come a long way since the advent of VR in the 90s (and the eventual winter it underwent) and the subsequent collapse of 3D Virtual worlds in late 90s owing to a lack of hardware processing power and bandwidth. Today's high-power GPU (Graphic Processing Units) machines have the power to render the most detailed, high-resolution imagery and videography, either on-premise or on the cloud. This forms a fundamental infrastructure enablement for the realization of 3D visual technologies.

Software engines, leveraging the GPU throughput, can render a photo-realistic scene replete with scenery, shadow, time-of-day simulation, terrain and buildings with unprecedented accuracy. 3D Scanning technology allows documentation of an object or a monument to an accuracy of 0.1mm with texture maps of the monument. Texture maps are digital images of the texture of the monument in various lighting conditions and at different points of the monument. It helps in building a photo-realistic monument in the software engine. The scan data can also include the nearby trees or stones/rocks thereby ensuring data collection of the flora and the environment to recreate an authentic environment in the virtual world. If the structure is broken, there is a possibility to recreate it with the use of this data along with associated ancient documents and manuscripts about temple architecture.

CHALLENGES

Adoption of Technology

This has two aspects, namely, with temple authorities and with consumers at large. In modern times, technology is perceived as a double-edged sword in society owing to the perceived notion that the cons outweigh the pros. Consider the usage of social media. Greater social media usage is associated with poor sleep and poor mental health in adolescents⁵. In terms of heritage, the perception of technology is quite similar.

It is observed that modern devices especially cameras, scanners and virtual reality headsets are not welcomed in traditional temple complexes for various reasons including damage to structures through irresponsible usage. There is a need to sensitize the technology teams to be socially responsible and work with noble intent and mindset at heritage sites so as to maximise the benefits for the temple authorities. There is also a need to sensitize the temple authorities about the tangible benefits of technology and how it could help their future generations.

Adoption of VR and AR technology in consumers is a challenge owing to the nature of the devices as well as pricing. While mobile phones are ubiquitous and therefore they help with proliferation of AR, VR requires head-mounted devices (HMDs) which are not preferred by many. There is a need to increase adoption of such technology with experiences that are more Indic, closer to our hearts and of value to youngsters and elders alike. For example, elders who

may not be in a position to physically travel to these temples can experience them through VR HMDs and receive a near-real experience.

Sthapathi

The knowledge of temple architecture and engineering is limited to very few families in India. It has been observed that a lot of people claim to be *sthapathi* but have no backing from the scriptures mentioned above. This has led to a proliferation of fake temple architects further diluting the sacred spaces in this sacred land. There is a need to create more *sthapathis* in the true sense so that such a treasure-trove of knowledge is not lost or diluted. This paper provides steps and recommendations for the same, thereby augmenting traditional skillsets in younger generation and generating jobs. There is a need to help today's *sthapathis* teach the younger generation in the medium that's attractive to the latter in order to increase memory retention thereby creating the next generation *sthapathis*.

Multi-Dimensional Team of Experts

There are multiple layers to our heritage – history, architecture, art, metaphysics, sound, energy, among others. There are 64 *kalā* and 40 *vidyā* mentioned in our *shāstra*. Therefore, there is a need to create a team of subject matter experts and approach this spiritual, sacred space with a scientific approach and deep knowledge. The paper proposes a plan for the same in terms of people and manpower which could also be codified into immersive course-materials.

METHODOLOGY

For every site, there are two stages of development to realise the multi-sensory, immersive experience – (1) Research Cycle and (2) Design & Development.

Since our heritage, history and culture are multi-dimensional, the retelling of our history warrants a methodology that undertakes multi-dimensional research, covering all aspects of the heritage site.

This approach will enable everyone to absorb it in a relatable manner. Design & Development focuses on the technology-enabled implementation of the outcomes of the research cycle in the form of a VR/AR temple tours, replete with infographics, animation, video and audio along with cinematics.

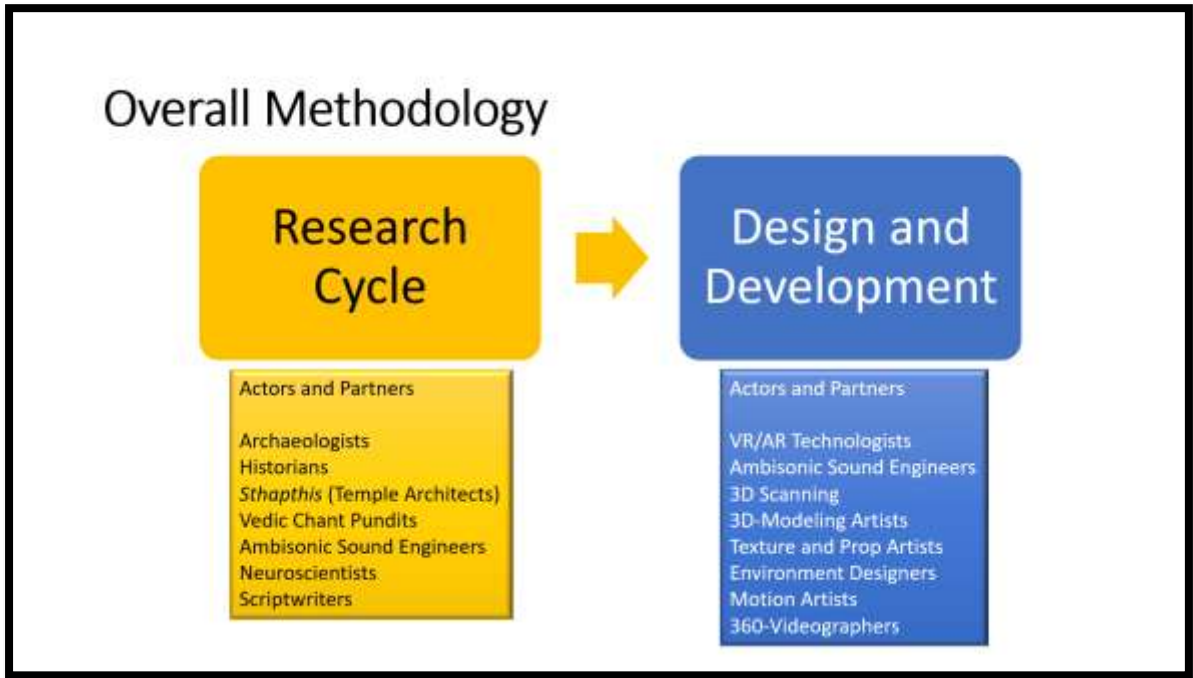


Figure 1: Overall Methodology of Execution

RESEARCH CYCLE

We perform a research cycle with the help of a multi-dimensional team comprising of Historians, *Sthapthis*, Film-makers, Ambisonic Sound Engineers, Neuroscientists and Vedic Chant-healers to initiate our work. This phase ensures tangible outcomes of multi-dimensional approach in terms of assets, infographics as well as a holistic, cohesive approach towards experiencing the site and its history.

Sthapthis quote from *shāstra* and provide revealing information nuggets regarding architectural specifics like pillars' dimensions and motifs' significance, the science behind the deity consecration, the temple's height in relation to the main sponsor's height and many such revelations for our scripting team to include into the overall script.

Other teams during research cycle include Vedic Chant Pundits and Ambisonic Sound Engineers. The Pundits select certain nodal points of the temple for their chanting regime. The chants include the ones dedicated to the main deity of the temple as well as deities that adorn the temples. The recorded sounds are utilized for neuro-research activities to assess the effects of chants on the listener's brain.

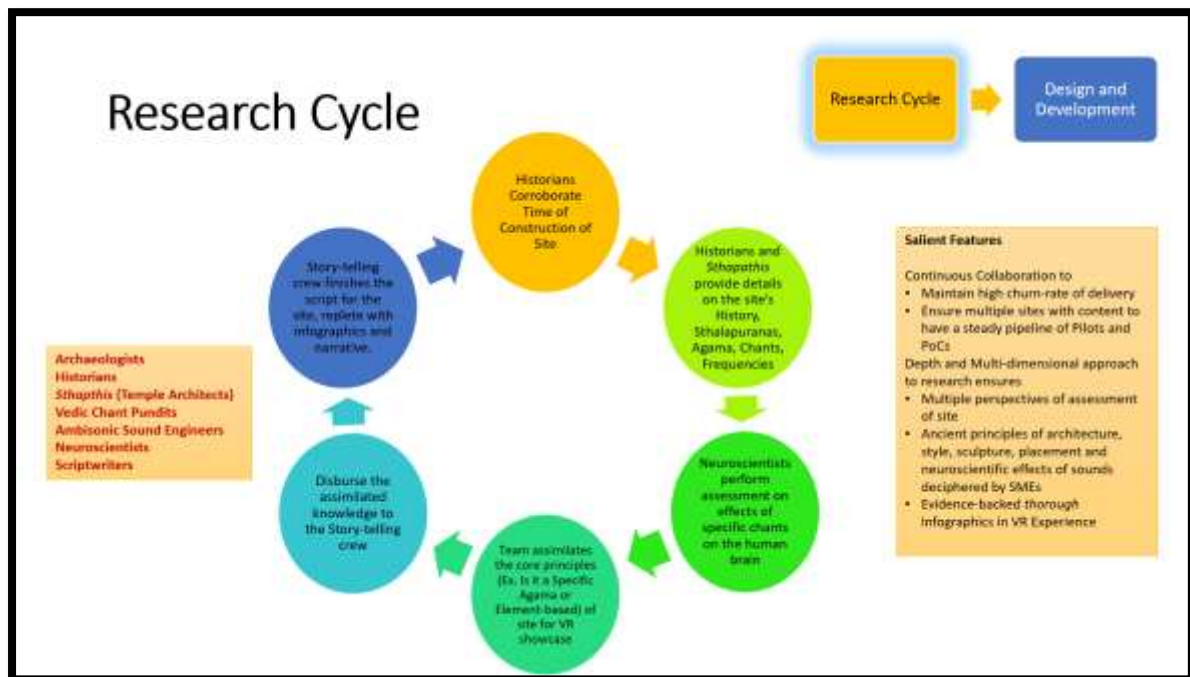


Figure 2: Research Cycle Explained



Figure 3: Vedic Chanting Recorded at Temple



Figure 4: Ambisonic Recording at Brihadeeswara Temple, Thanjavur, Tamil Nadu

Ambisonic sound engineers, using the audio recorder, move around the temple premises to pick areas of particular aural resonance and measure impulse response (IR) at that position. They repeat this process across various nodal points of the temple. Once the details are captured, a map is created with these nodal points marked, for the design & development teams to embed the soundscape at the right points in VR and AR experiences. Sound engineers undergo a training regime on how to extract ambisonics sound and integrate that with the software platform prior to becoming a part of the research team. This output is also helpful in research on archaeoacoustics, the science of sound in heritage monuments.

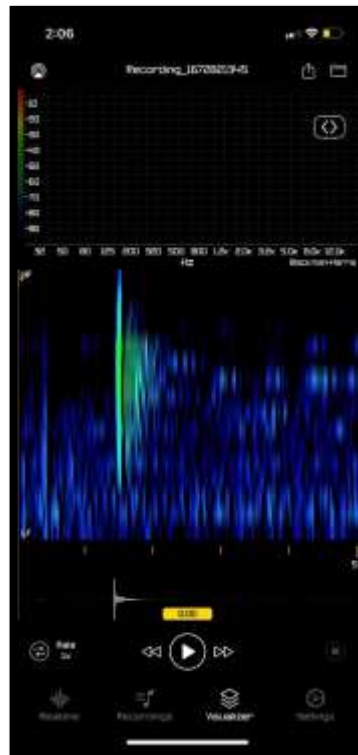


Figure 5: Impulse Response as recorded at Brihadeeswara Temple, Thanjavur, Tamil Nadu

DESIGN & DEVELOPMENT

With the research cycle completed and relevant data gathered, we embark on the design and development of the heritage site as it appears today as well as how it looked in the past. In so far as the latter is concerned, as per Sundstedt et al. (2004), the key practical considerations⁵, when undertaking a reconstruction of a heritage site using immersive technology, with a view to investigating how it may have appeared in the past, are

- ✓ Constructing an accurate geometric model
- ✓ Providing detailed surface materials and textures
- ✓ Determining the spectral properties of the ancient lighting materials
- ✓ Creating a light model for flame
- ✓ Rendering the model with physically correct lighting

Latest technologies like LIDAR 3D Scanning capture a site's point-cloud data up to 0.1mm resolution, thereby providing precious data about the site's geometry, both indoor and outdoor. The scanner also stores the data pertaining to the materials of flooring, wall, pillars etc. which helps reconstructing the temple in various visual software engines.

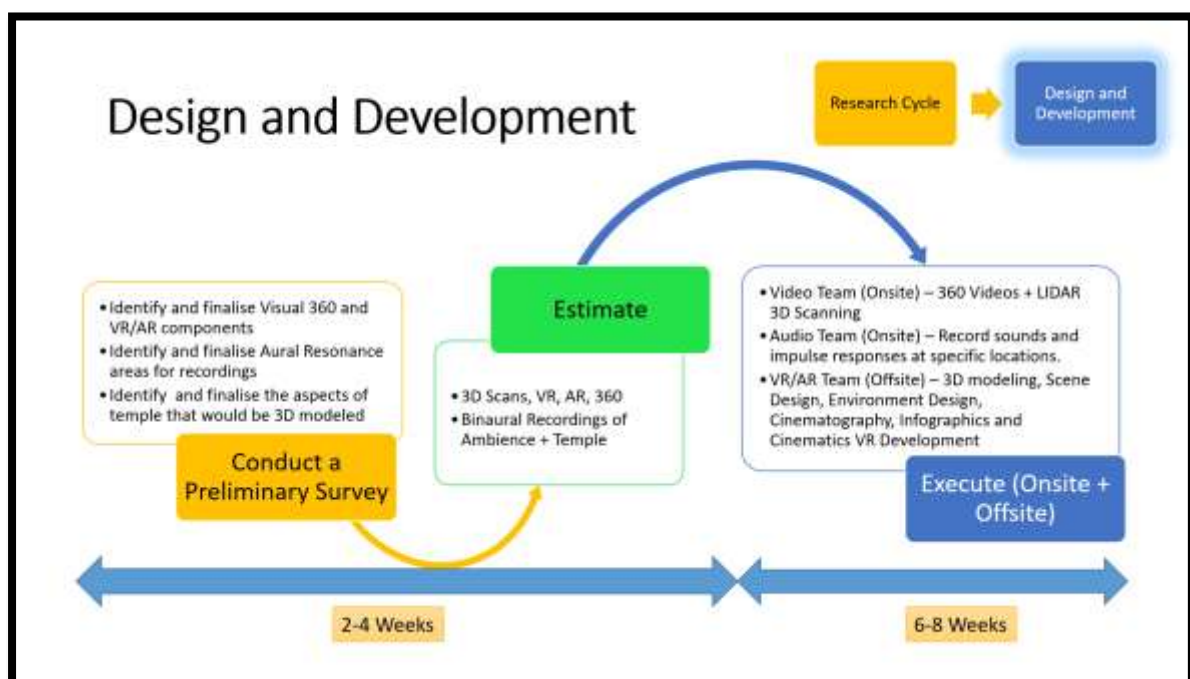


Figure 6: Overview of Design & Development



Figure 7: Drone preparing for 3D Scan

(1) 3D Scanning: LIDAR Scanners are mounted on drones capable of carrying higher payloads. This enables aerial scans to capture the surrounding environmental details for posterity. Hand-held scanners are used on ground to capture intricate details of sculptures, pillars etc. in addition to the aerial scan details.

(2) 3D Modeling: The resultant point-cloud and textures are imported into various software like Blender, ZBrush, Unreal and Unity Engine to create accurate 3D models of the entire site

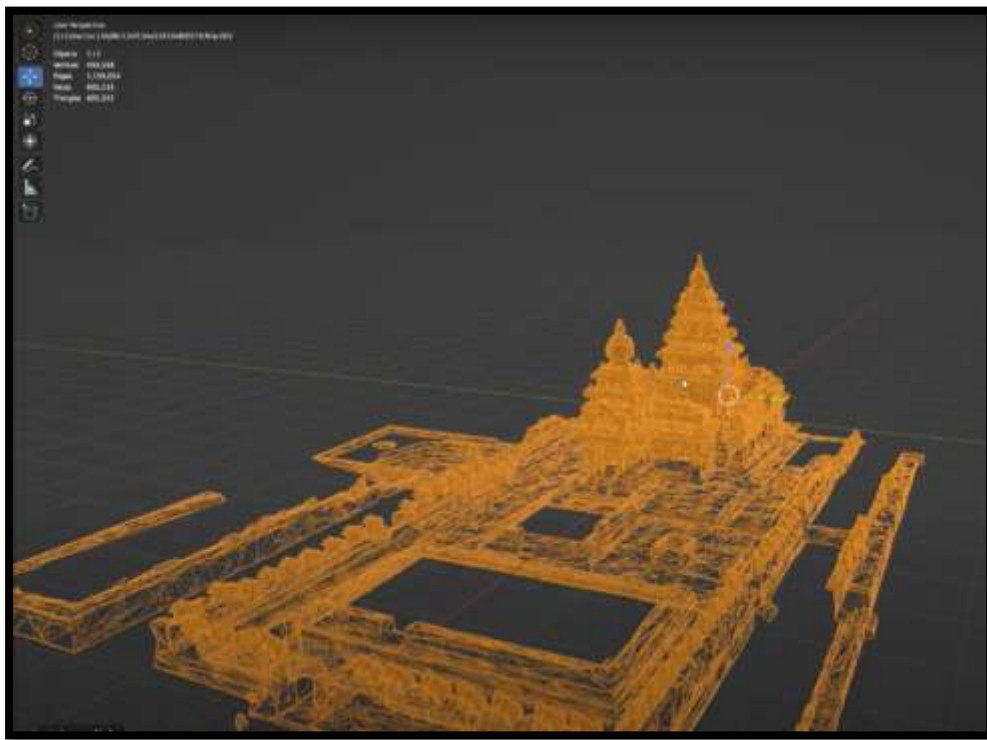


Figure 8: Point-Cloud and Mesh of Temple

Thereafter, the model is tested against various lighting conditions to ensure there is no inconsistency in the collection of data in terms of holes or gaps.

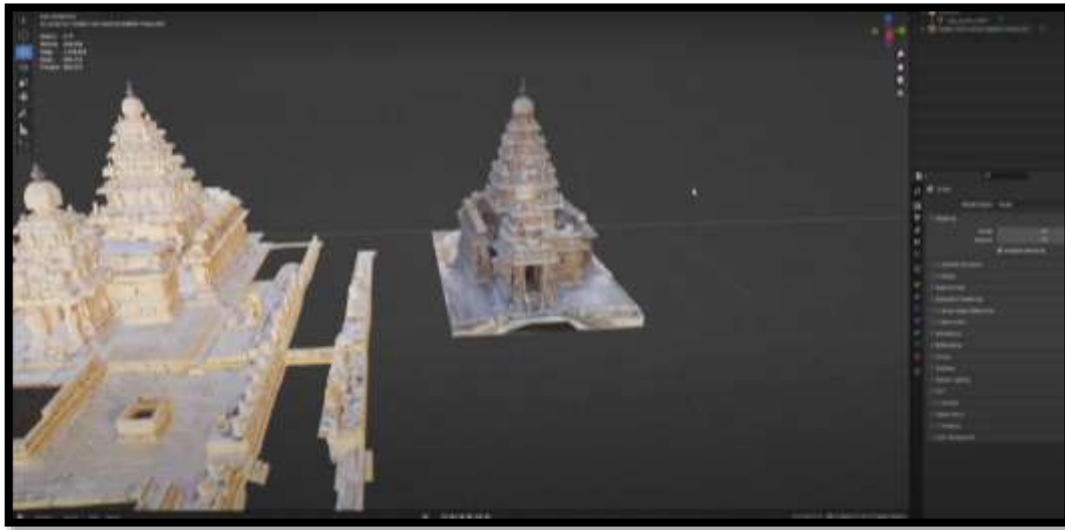


Figure 9: 3D Model in various lighting conditions

(3) Scene and Environment Design: The next step is to replicate the surrounding environment as in reality. This includes buildings, roads and other infrastructure. It also includes the flora at the location and creating 3D models of the tree species.

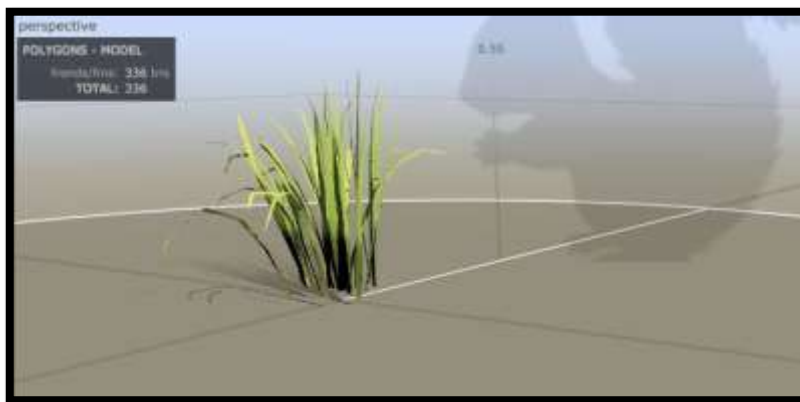


Figure 10: 3D Modeling of Local Flora

The terrain is created based on the point-cloud. It includes depth perception as well as gradient in the environment. The software also ensures lighting constructs follow the laws of physics and provide the optimal shadows. The same can be programmed as well, requiring advanced knowledge of behaviour of light.

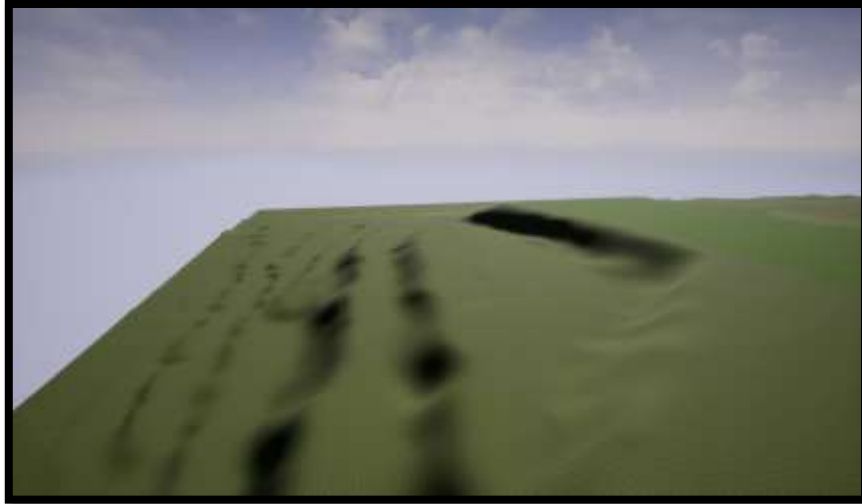


Figure 11: 3D Terrain Topology

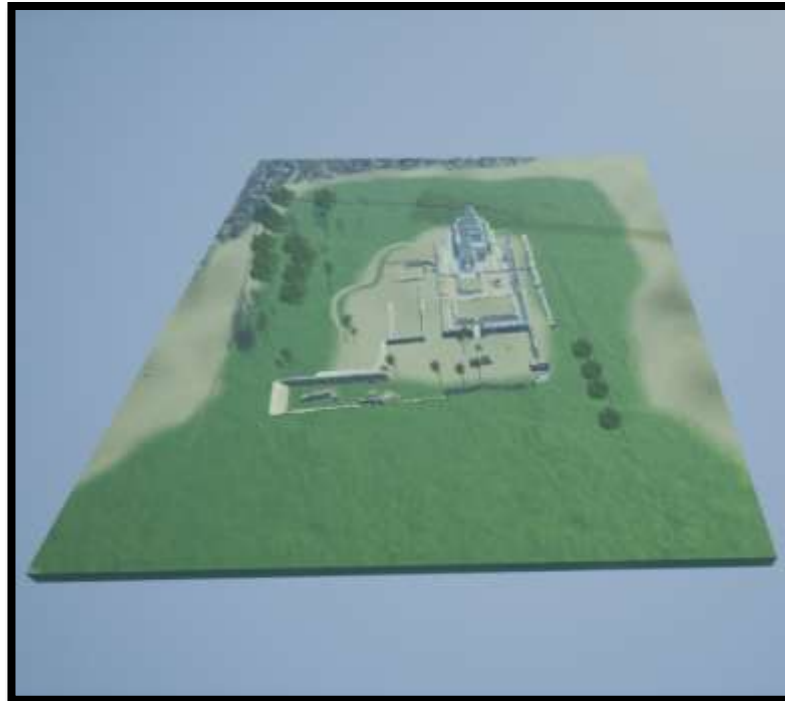


Figure 12: Final 3D Model of the Temple and the Environment

(4) VR/AR Development: Once the model is ready and workable on the software, we proceed to create the entire experience in terms of User Interface, User Experience, Icon Design, Colour Scheme, Fonts, Infographic Texts, Cinematic Videos with Audio Narrative which would require cinematography and syncing as well. Software package is designed for particular Head-

Mounted Devices (HMDs) in case of Virtual Reality and on target mobile devices in case of Augmented Reality. The development process is iterative where every asset is integrated into the VR/AR software and checked for FPS and other metrics to ensure optimal performance under all conditions. Interactive Design elements are iterated for best visual design and performance. This is a critical phase of the development as the hard work and attention to detail undertaken in earlier phases comes to life in this phase. This is pretty much the way people will experience the temples in VR/AR. Ambisonic Recording undertaken in the initial phase is plugged into VR development and additional programming carried out for the most natural ambisonics sound experience.

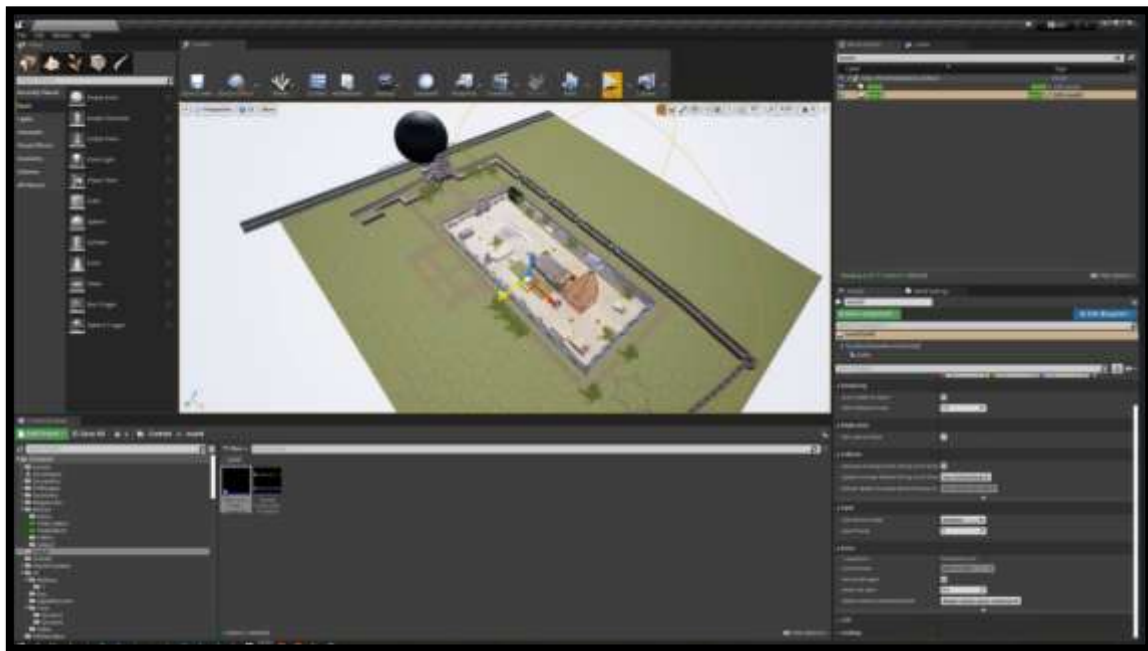


Figure 13: 1Ambisonic Sound Design in Software Engine

The black ball at the entrance of the temple complex is considered the sound source. The projections with various elevations from this source denote the angular displacement of the sound with respect to the movement of the actor across the temple complex. This is an iterative process to obtain the optimal and cohesive directional sound reproduction within the engine. Intricate sound design for every corner of the temple would involve intricate programming and projections to provide that near-real experience.

Graphic elements like buttons, fonts, colours constitute user interface. They are an important aspect of the overall interaction design and need to be created keeping in mind aesthetics and functionality. Here's an evolution of the floor icon for a teleporting experience.



Figure 14: Evolution of Icon Element



Figure 15: Buttons and other UI Elements

Once the interaction design and user interface elements are frozen, we get into realizing the storyline that was handed over by the scriptwriting team during the research cycle. A visual storyboard or mood board is created that highlights navigation, the areas of focus during navigation and placement of videos within the entire navigation to ensure the resulting VR/AR experience is smooth and with all the research information plugged-in.

ANALYSIS

Following the methodology described above, we created a prototype VR experience about the Nandi Monolith at Lepakshi, Andhra Pradesh. The experience was accompanied with sound and infographics on the history of the location (Ananthapur district) and how today's dry and arid region was once a thick forest with numerous water bodies. We also covered the significance of Nandi via narrative and infographics. We created 2 versions of the prototype – one with infographics, narrative and sound and another one without any of these elements – a pure visual experience.



Figure 17: Prototype VR Experience of Nandi at Lepakshi
(https://www.youtube.com/embed/_ET3Bl5CuZo)

We built full-fledged experiences of four sites – Shore Temple at Mahabalipuram (AR), Brihadeeswara Temple at Thanjavur (VR), Rani ki vav at Patan (AR) and Harminder Sahib (Golden Temple) at Amritsar (VR). Every aspect of the methodology including research cycle and design & development was followed during the making of these experiences. The Trailers associated with these experiences are being shared here to get a glimpse of the actual VR and AR experiences.



Figure 18: Video Trailer for the Shore Temple Experience Released during G20 in 2023. It shows 3D Rendered temple with waves animation. The final experience is in AR with large 3D printed model of the monument

(<https://www.youtube.com/embed/6zagVIFOQMA>)

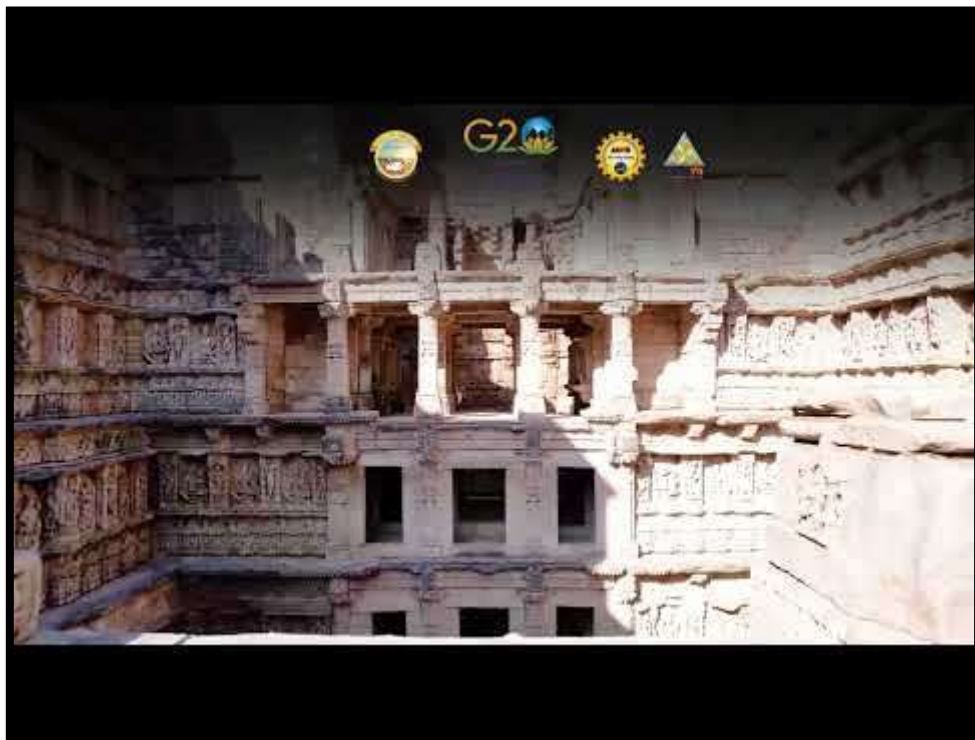


Figure 19: Video Trailer for Rani ki Vav Experience Released during G20 in 2023. It shows 3D rendered step well with water storage principles in animation. The final experience is in AR with large 3D printed model of the monument.

(<https://www.youtube.com/embed/EEHy4Vscylw>)



Figure 20: Video Trailer for Brihadeeswara Temple, Thanjavur released during G20 in 2023. It shows 3D rendered temple with temple courtyard scenery. The final experience is in VR
(https://www.youtube.com/embed/WB_oll8m7yc)



Figure 21: Video Trailer for the Harmandir Sahib Experience released during G20 in 2023. It shows a night scene of the Golden Temple with Historical events of Amritsar. The final experience is in VR
(<https://www.youtube.com/embed/MN1exlEly4s>)

We leveraged the prototype experience as well as these full-fledged experiences as case-studies at various public events to gauge the market appetite for heritage experiences and feedback on the technology including the hardware, among many other facets that are outlined in the “Key Findings” section.

KEY FINDINGS

Has technology of today enabled ancient sites to come alive? Has technology helped people relive the past? Our analysis is multi-dimensional as is the case with all things related to heritage and history. We perform our analysis across the following dimensions:

- ✓ End-users
- ✓ Technology
- ✓ System
- ✓ Community

End-users

The main intent of deploying immersive technologies and deep research into our heritage and history is to make the learning appealing and enjoyable for our end-users. Additionally, the need to instill a sense of pride and self-worth in our younger generation, the future of our nation. With this in mind, we present some of the audience-responses, behaviours and recommendations based on our work across multiple projects presented to the public at various locations across India.

In the year 2022, at the Bengaluru Technology Summit, a prestigious industry event, we setup a space for the audience to partake in our VR experience across 3 days. The experience was a prototype of the Nandi Monolith at Lepakshi, Andhra Pradesh, having no sound and no explanation of the significance of the site. Our intention was to test the curiosity in the market for heritage experiences, with a sub-optimal prototype. The audience would see the Nandi Monolith and surrounding environment in a 2-minute walk. Will it engage the audience? Will the experience be something that they haven't witnessed before? Will they want more?

Our hypotheses with respect to the market appetite for heritage experiences was proved right. The space had the longest queues at the event, with people getting their friends and families the next day to partake in the same, sub-optimal, experience. Elders, students, teachers and people from diverse communities enjoyed the experience and opined that this should be the mode of learning history in schools and colleges and for tourists to learn about the monuments.

Some users provided constructive feedback such as “the experience is very basic and can be much improved” or “there is only one site. Work should be done on more places to depict the diversity of our nation”.

In the year 2023, as a part of the G20 Presidency of India, we were commissioned by the Ministry of Education, Govt. of India, to create VR and AR experiences of heritage sites across India and display them at various G20 delegate events at Chennai, Amritsar, Bhubaneswar and Pune. As a part of the Education Working Group (EdWG) of G20, four priority issues were identified for deliberation⁶:

- Ensuring Foundational Literacy and Numeracy especially in context of blended learning
- Making Tech-enabled learning more inclusive, qualitative and collaborative at every level
- Building Capacities, promoting Life-long Learning in the context of Future of Work
- Strengthening Research, promoting Innovation through richer collaboration and partnerships

Would VR and AR appeal to the masses to engage in tech-enabled learning and bringing in a sense of inclusion for all, the world over?

The events had, on an average, 90 foreign delegates partaking in our experiences of Indian heritage sites. Some of the notable countries included Spain, US, Germany, Netherlands, Saudi Arabia, UAE. They enjoyed the experiences and were enamoured by the depth of knowledge of our ancestors in the fields of water conservation, temple construction, sciences and architecture and philosophy.

Schools, colleges, researchers and the public were invited for 2-3 days per event, to visit various spaces like ours. The crowd management at our space used to be a challenge. In fact, on the last day of the respective events, we would cordon the space so that we could pack up our equipment and transport it back to the Ministry of Education. Many people would request for an experience at the last minute, politely declined by us. That reinforced the hypothesis that there is curiosity and thirst in the audience for heritage experiences.

Some incidents from these events are unforgettable. For instance, in Chennai, a student walked up to put on the VR headset and before doing so, removed his shoes (circled in the image below, in orange) and folded his hands. He witnessed the Brihadeeswara Temple.



Figure 22: Experiencing heritage sites in VR - Barefoot



Figure 23: A school student in Chennai experienced both VR and AR and enjoyed them



Figure 24: Kids partaking in VR Experiences of Heritage Sites

Across all locations, we witnessed long queues and an innate curiosity to know how the experiences were built. Many students, in under-graduate studies, wanted to join us to build these kinds of experiences. Many of the video testimonials recorded at these events mentioned this is how history should be taught so that people get to know better about who they are and where they come from.

Technology

One of the thoughts that come to mind when we hear the word “Technology” is “Cost”. Indeed, technology is expensive. More importantly, devices that we own become obsolete the day it is sold to us. Such is the speed of development and evolution of technology. With state-of-the-art immersive technologies, the scenario is no better, if not worse. Immersive technology is rapidly evolving, perpetually in search of photorealistic experiences and compact hardware. That said, the realism possible today is phenomenal, as compared to visual technologies in the 90s or early 2000s. To add to it, the 3D scanning technology has matured and delivering on its promises of providing high-quality scans. In this section, we will focus on the issues faced by the development team in the usage of these devices as well as building the experiences.

(1) 3D Scanning: Most of the 3D Scanners in the market are from Europe and USA and are tested in various conditions conducive to those regions. In our case, 3D scanners were not operational at high ambient temperatures. It would stop scanning and switch off until cooled off. This led to an invaluable loss of time for the team to scan the heritage sites. Additionally, it pushed our schedule owing to delayed post-processing as a result of delayed scan data delivery.



Figure 25: 3D Scanners being cooled down to resume operations

The second issue was with respect to the data retrieval processes undertaken by the 3D scanner providers. We had recorded Brihadeeswara Temple scans across a period of 4-5 days and the same needed to be rendered on cloud, by the providers. After weeks of inaction, it was brought to our attention that the site is too large and that the software is not capable of scanning such heavy workloads! Clearly, the lack of Indian data and systems for robust testing of these products came to the fore. Our team devised a way to push smaller area scans to the providers

and we could receive the data in quick time. But, this added to the overall development effort as the models needed to be stitched together, imported one by one, and assimilated in the same lighting conditions in the software.

Overall, 3D scanning technology is phenomenal as it provides a digital twin of the physical premises. We have data pertaining to the exterior of monuments to a resolution of 1mm. In fact, some of the experiences included museums inside these monuments. With little or no effort in post-processing the data, these museums were photorealistic and were highly appreciated by one and all. On the other hand, the unpreparedness of the products in Indian conditions and for large scale data is worth a consideration for these products' future development.

(2) Virtual Reality: VR as a technology came to the fore in Mid 90s. The technology has not yet reached the mass consumption levels, the world over. That said, the ancillary technologies for VR like 3D Scanners, High-processing Hardware (GPUs) and Network infrastructure (5G) have all come together to make VR a high-fidelity, rich visual experience. The price of a VR HMD has also come down to a reasonable rate for considerable uptake in the world market.

Our VR experiences were powered by High GPU Gaming Laptops (NVIDIA RTX 3060 series) with the HMD being the visual display unit. Usually, HMDs come with their own processors but they are not powerful enough to render heavy (TBs of model data) and rich visual content (photorealism with water waves, for example).

One issue we faced was with the optimal polygon count (or polycount, in short) in the experience. While our 3D models had a polycount of 70,000,000 to 80,000,000, high-end VR experiences can only tolerate 7,00,000 to 8,00,000 polycounts. This means a direct loss of resolution and quality and needs a fine balance to ensure the realism of the experience is not broken. This, we believe, is a pain-point that's worth considering to be fixed by the HMD providers globally. There are some HMDs that perform much better but they are made in countries that are geopolitically not in alignment with India. Today's standard way of solving it is by performing a retopology (retopo in short) using software like Blender or Maya. The intent is to bring down the polycount without eliminating sufficient, crucial architectural data. Another method is to ensure dynamic loading of the experience so that all the memory and processing is utilized for the current scene and as the user moves ahead, dynamic render of the next scene occurs. This saves processing power to a great extent but requires coding to ensure dynamic loading of the scene. With every head movement, this method will be triggered and optimizations performed, without compromising on the latency to ensure the consumer gets a seamless experience.

The team developed a program sequence to control the texture and flow of water in the pond at Harmandir Sahib, Amritsar (popularly known as the Golden Temple). It took considerable testing to make it perfect. In the end, everyone who experienced it was blown away!

While VR provides visually rich experiences, ambisonic sound compliments it with rich, immersive sound – directional sound, crucial to bring a sense of embodied cognition in the viewer. With ambisonic sound, training and post-production is key. The sound engineer needs to assess the best location for IRs and other sounds such that the same is translatable in VR experience. Software engines handle ambisonics quite well and provide configuration and customisation capabilities to the development team.

True to our multi-sensory experience approach, we brought in haptic experiences also like feeling a stone-wall and the water surface. They largely work on force-feedback yielding vibrational sensory experiences to the user. But they largely miss codifying the texture, material and temperatures. These parameters are of paramount importance in providing a realistic multi-sensory experience. As a result, the experience was disappointing but our team is working to constantly improve it beyond what the product provides.

In summary, technologies today are really advanced and provide way more opportunities than they did in the past. The landscape has matured and both hardware and software are constantly upgraded and able to meet the challenges of the software developers. Today's animations are photorealistic and allow teams to convert their visual and aural dreams into reality.

System

System, for the purpose of this paper, includes the people and processes in various Govt-run bodies. As a part of heritage site visits, there is a need to interact with and seek permissions from various authorities like the ASI (Archaeological Survey of India), Local Police and other District Authorities.

(1) Archaeological Survey of India (ASI): The first step is to seek permission from ASI to shoot at heritage monuments which fall under their purview. This is done by applying online, one site at a time. While online application is a great boon and eliminates yet another means of corruption, for large-scale projects across multiple sites and states, individual applications and their follow-ups to fruition is a labourious task and an operational hassle. Keeping in mind, the bigger picture of potential proliferation of heritage tourism with cutting-edge technologies, these processes could operate in bulk at the authority level, thereby allowing teams to focus on their work rather than these hassles.

Secondly, there are different rules or norms at the local ASI level. While some ASI authorities allow full access and help clear the crowds for an accurate 3D scan (any presence of objects and people impede the output of the scan and therefore, its quality), others chose to ignore the same. By and large, the ASI authorities are very helpful and cordial. Our 3D Scanning team would leverage the ASI offices for network connectivity, essential for scan data. It must be noted that not all ASI locations have high-speed internet. The team had to travel to the nearest city to ensure the scan data was processed. This increased the timeline of scanning a site to a few more days, adding to the operations cost and additional hassles.

ASI could benefit from looking at bulk-site approval processes for organizations entrusted with documenting heritage monuments. Secondly, there needs to be basic amenities like high-speed internet provided at the local offices.

(2) Local Police: One needs to seek permissions from both the ASI and the local police authorities for usage of drones at heritage sites. Again, the experience was mixed. While some local police authorities were very efficient and quick in providing approvals for timely shoots, some local police authorities didn't provide the approval until the very last day following high-level escalations. Flying drones is not permitted beyond a certain number of hours during the day time. It was also noticed that some of the heritage sites were not open during those hours. This led to a major reshuffle in planning the shoots without the drones, thereby leading to a loss of scan data. More importantly, a lack of data for heritage site preservation and digitization. In some places, it was not known as to who the approving authority was, leading to greater time-delays.

Drone-permissions, as a process, could be streamlined at the national and state level, including contact details of authorities and the next-in-line.

Community

Community refers to the researchers, archaeologists, historians, temple priests, titular kings of cities, subject matter experts associated with particular heritage site(s) as well as ground personnel and tourists and the local community. As stated earlier, a large section of the community welcomes technology into sacred sites, once our noble intent is made known to them. Many in the community despise the use of technology and qualify it with damage done to structures by tripod stands and other hardware. As a passionate team fully focused on heritage sites, we took utmost care in not violating any rules or laws and ensured zero-damage to the sites.

We were unable to scan and record the interior of the temples due to absence of permission. We tried sensitizing the titular kings and the priests on the usage and benefits of technology but we understand that this requires a shift in mindset. As a result, interiors of the site are not digitized. We completely understand that the *garbagriha* should not be approached at all but the rest of the interiors could have been captured for digitization and preservation. Again, the approval needs to be given on a case-to-case basis keeping in mind the track record of the team and its intent. In fact, some end-users wanted to explore the interiors and were a tad bit disappointed that it was not possible.

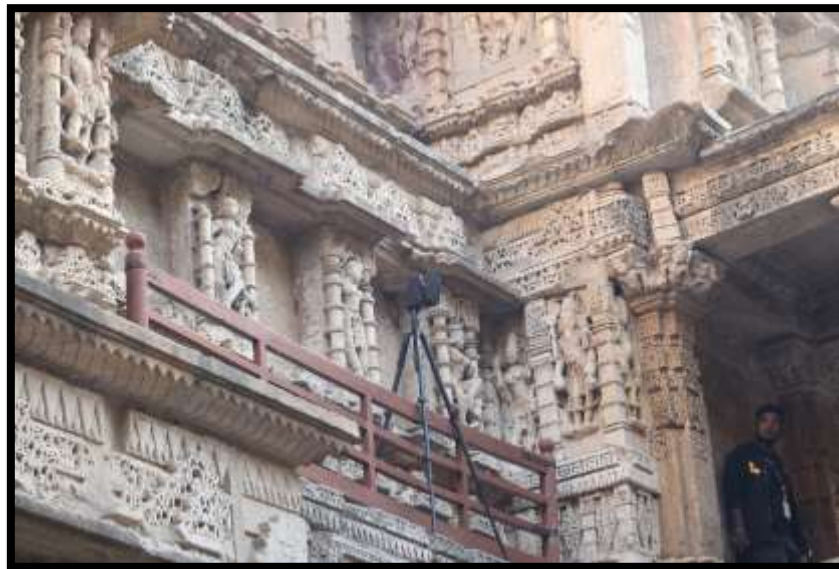


Figure 26: Utmost care taken at heritage site to ensure zero-damage. Image shows equipment being deployed at various parts of heritage site, including corners and elevated areas.

POLICY PERSPECTIVES FOR THE FUTURE

We propose the following policy and administrative steps to streamline the process of content development for heritage, the skill development required for it along with administrative programs that can be organized at various levels from college/university to Central/State Govts.

a. Identify key policy and administrative guidelines

- **National Education Policy (NEP)** should leverage technology to bring back emphasis on Heritage. Technology can enable students to learn about History and Heritage in an immersive manner as explained above with e-learning. Many researches in the past have established the efficacy of visual learning over text-based learning, in terms of retention and recall. Therefore, immersive, visual technology could be a powerful

medium of information dissipation that has the potential to disrupt the learnability of youth as well.

- **Archaeological Survey of India (ASI)** should look at setting up Immersive Experience Centres at select heritage sites to engage visitors with in-depth VR/AR/360 experiences of the site, including time-travel to its past. Tourists, local and foreign, are largely unaware of the significance of the sites. To top it, an inconsistency in the information of tourist guides at these location means that the tourists get little or incorrect information. With these immersive experience centres, authentic information can be provided to the tourists thereby bringing in a shift in their mindset with regards to Indian history, arts, culture and heritage.
- **Skill Development** in the field of VR/AR and immersive technologies is essential to scale up content development and proliferation, given the multitude of sites in India and associated cultural ethos. Today, engineering colleges largely ignore this field of study. While lakhs of students are churned out every year as market-ready, their skills in this emerging technology are nominal or non-existent. Upskilling and reskilling the current workforce and students will go a long way in creating an ecosystem for content development in the field of heritage.
- **National Digital Tourism Mission (NDTM)**, as a policy, is well-intentioned and well-drafted. The focus on startups being a part of the entire ecosystem and the conception of UTI (Unified Tourism Interface) much like today's UPI is indeed revolutionary. Heritage Tourism startups and industries should be made a part of the early formulation of NDTM with pilot projects. The authorities at Tourism Department, Govt. of India, need to be made aware of emerging, immersive technologies and their potential.

b. How to operationalize above suggestions

Here are our recommendations on **Skill Development**:

- ✓ Universities should call for public discourses, paper presentations, talks at a state and national level. Institutions should have regular conferences to source heritage knowledge keepers and heritage knowledge givers and help them network with each other.
- ✓ All Government projects involving Culture, Tourism ministries should have a list of these knowledge keepers and givers to source from. Currently, this is broken and has a potential to further debilitate the cause of upholding the functioning of our heritage and culture.
- ✓ Training students in Universities on Industry 4.0 (Virtual Reality, Augmented Reality, Blockchain, AI, Metaverse etc.) with internships with startups and other companies working in heritage technology (**HeriTech**) vertical, thereby creating skilled manpower and generating jobs. Youngsters are encouraged to build a career in this niche field.

- ✓ State and Central Govt. to ensure funds within Startup India or statewide initiatives to have a funding allocated for **HeriTech** vertical so that startups could make use of them to build content. Content development is part of producer economy and is traditionally expensive in India.
- ✓ Hackathons to be organized at university level as well as Govt level for various initiatives of Culture Ministry and Tourism Ministry.

Some of our suggestions on operationalizing immersive technologies within **NEP**:

- ✓ NEP already includes the need for using immersive technologies in schools in its formulation as noted in sections 24.4(d) and 24.5.
- ✓ Allocation of funds for targeted course-content in immersive technology for schools is a must. Expecting this to be done as a part of CSR or Section 8 company defeats the purpose of providing world-class course-content for the students.
- ✓ Inherently, the technology is expensive and the content development is largely visually-centric which opens up the realm of subjectivity in terms of content aesthetics. There is a need to ensure content development is undertaken as per the research cycle and design & development methodology outlined in this paper.
- ✓ Pilots at select schools with course-content development and feedback across primary and secondary education would go a long way in faster implementation of immersive technologies as a part of NEP.

Here are some thoughts on operationalizing **ASI** recommendations

- ✓ Setting up Experience Centres at select heritage sites with the content already created could be considered as pilot execution.
- ✓ Culture ministry and ASI should allocate funds for proliferation of heritage tourism not only at the regional level but for global tourism as well. Many VR-based tourism portals exist in US, UK, Australia which can be leveraged to provide rich, immersive content of our heritage sites for tourists to discover and visit India.
- ✓ ASI should look at using scanned 3D models for preservation and protection of the monuments. The content should be stored at a central location, easily retrievable and usable by the staff for swift, corrective action when needed.
- ✓ ASI policies on heritage site shoot permissions should be relooked at, to help increase efficiency of the content development teams. It has to be noted that the content development teams focused on heritage look for permissions in bulk so as to cover a

large number of sites within given time and resources (people and equipment). This needs to be deliberated as a policy change.

- ✓ ASI should help in crowd management and control during such shoots as these are activities of national importance that are being carried out. These shoots help digitize the heritage sites and preserve them for posterity. In the case of natural calamities or any mishaps which cause harm to these sites, the digitized data would act as a reference to restore the damaged areas of the site. A case-in-point was the reconstruction of cathedral at Notre Dame, France.

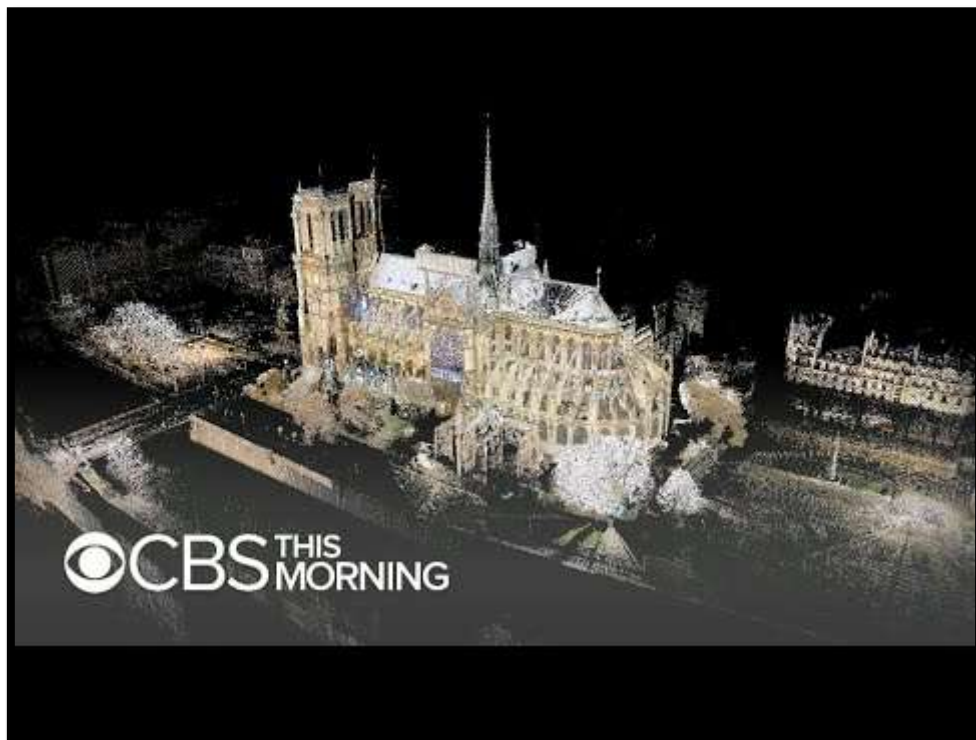


Figure 27:3 Restoration of Notre Dame made possible due to 3D Scanning Data
(<https://www.youtube.com/embed/sQmlxPVtOGk>)

Here are some suggestions on **NDTM**

- ✓ Tourism ministry should look at heritage tourism as the fulcrum of NDTM and enable onboarding and empanelling of startups and agencies working in this field.
- ✓ Tourism revenues in India today are comparable to some of the major cities of the world. Much needs to be done in increasing the revenues. Heritage tourism, especially of temples, is an under-tapped aspect of tourism revenues and it would augur well for the Tourism ministry to invest in creating experience centres as part of Incredible India campaigns across the world.
- ✓ Investments by Culture and Tourism ministry in the order of billions of rupees into creating a metaverse for temples and heritage sites would ensure we future-proof our

ancient past with modern technologies. This should not be reactionary but rather a planned, deployable policy initiative. China recently announced similar plans at a cost of \$6.9Bn⁷.

c. How it benefits and to whom

- **Culture and Tourism Ministry** – These policies could ensure technology would initiate heritage content proliferation. It could benefit the Tourism department in terms of alternate channels of revenue, and as a tool for Tourism Discovery, thereby increasing foot-fall in India for these heritage sites. ASI could leverage the 3D models for their research work as well as plan maintenance works across the sites.
- **Students** - For students, learning History would be enjoyable and immersive with high recall of memory. For young adults exploring their History and Heritage and wanting to visit places of interest, this would be very helpful, with potential cultural exchanges between India and other nations which evince interest in this program. Additionally, skill development programs across the nation would ensure the next generation is equipped with all the technologies and skills to take on the metaverse revolution.
- **Elderly** - For the elderly who may be unable to travel but have a yearning to see places of worship or places of heritage and tourism, this technology would be a boon, enabling them to travel and see places despite their physical condition. The opportunity is more powerful when it comes to senior citizen NRIs and their yearning to experience the heritage of India.
- **Partially Visually Impaired** - The power of visual learning is beyond doubt. This would be beneficial to the partially visually impaired people, young and old. There have been pilot projects and researches conducted worldwide and in India with Virtual Reality for partially visually impaired. Sensations of light of different intensities (colour/brightness in visual language) convey different details to the partially visually impaired. They have suggested using audio narrative with highly descriptive commentary that could describe what is being seen as well as haptic devices for a sense of touch-and-feel. This could benefit them to learn and visualize History like never before.
- **Prime Minister's Panch Pran** – When PM Narendra Modi ji announced the *panch pran* (5 oaths), it was a call to shift every individual's mindset. Aspects like Decolonising Minds as well as taking pride in heritage are the fulcrum of the *panch pran*. With this technology and the policy suggestions above, it can indeed have a large-scale impact on the younger generation in decolonizing minds in the days and years ahead.
- **Heritage Keepers** – Last but certainly not the least, this technology and suggested policy changes would proliferate jobs and services in the heritage sites sector (temples)

ushering in a wave of economic independence in the lives of heritage keepers who are today dwindling or seeking other jobs, owing to lack of monetization opportunities in the sector. This has resulted in lost knowledge and abandonment of our *shāstra* for lucrative jobs in the industry sector.

Leveraging today's technology, we could definitely look at high degrees of inclusivity in education, research and tourism & culture proliferation in the field of History, arts and heritage.

FUTURE DIRECTION

Technology has evolved to bring visions to reality, literally. With Digital twins of buildings and malls, technology today provides the ability to visualize aspects of art, architecture and engineering to great detail with hyper-realistic visuals and sounds. This paper has attempted to provide methods to realise this potential for ancient monuments – one of the key ancient knowledge repositories. While some policy recommendations have been highlighted in the research paper, here's a summary of issues across various aspects like technology, funding, cultural resistance along with probable solutions or recommendations for further research.

Firstly, there is a **lack of data** pertaining to the number of people practicing traditional roles like *Sthāpathya*. A focused approach on preparing a registry with relevant information and access points would help in actionizing plans related to their well-being and development. A detailed list of traditional skillset needs to be prepared and reviewed by traditional experts prior to executing the survey.

While **policies** like NEP and NDTM are in place, their implementation needs attention. The paper has provided certain tangible actions for the same. The paper also wishes to acknowledge the SHRI (Science and Heritage Research Initiative) by Dept of Science and Technology (DST), Govt of India. Relevant synergies between academia and industry could be harnessed for viable execution of projects and programs related to heritage in India.

Cultural resistance has been noted in this paper as a limitation. It's understandable as a generational trait but needs attention and a consistent approach. Future exercises and surveys could pave the way for the methodology of addressing this limitation. This impedes an otherwise robust economic development of the temple and its surroundings i.e. the opportunity to bring back the ancient temple economy paradigm. Consistent approaches in sensitization to the temple trusts and authorities could help beyond the surveys and exercises.

Currently, the **skillset** required to operate the hardware or even develop the 3D content is sparse. Skillset development is required in the areas of technologies like 3D Scanning, 3D Model Development, Animation, Content Development, Environment Design, Lighting Artists, Rigging Artists, Motion Capture Mechanics, Ambisonic Sound Recording and Rendering, among many other visual, immersive technology segments. The WAVES initiative by the I&B Ministry is a step in the right direction, especially, with the first ever institute that

would teach above mentioned skills – Indian Institute of Creative Technology (IICT) in Maharashtra. More such initiatives are needed for rapid skill development and scaling across the country.

Culture and Heritage has attracted very little industry interest in terms of an industry vertical or a line of business. While CSR **funds** include heritage as a recognised vertical, few industries opt for it. There is a need for sustained value-proposition of culture and heritage for society at large. Researches should be undertaken at scale, in this realm to underscore the significance of our civilizational relevance in today's world. Culture and Heritage requires government funding as primary source of investment and financing for projects. The potential of HeriTech is huge as highlighted in this paper but needs infusion of large-scale funds. Any new initiative or mission on a grand scale requires government support and focus. While some section 8 companies and trusts are sustained by donations and private funds, the author recommends a Fund-of-Funds for Culture and Heritage Startups (LLPs or Pvt Ltd) which work on deep tech like VR, AR, AI, 3D Scanning etc, as these are capital intensive and have high potential of scaling and global presence. These startups could usher in the Indian Soft Power through cutting-edge technology for global outreach via new media, in addition to seminars, conferences, books, journals, music, dance etc. There is a need to sustain risk-taking startups that operate in a hyper-niche segment like culture and heritage. Fund-of-funds from the Govt of India would help bring up such promising startups across the nation, generating employment and ensuring high-talent pool is deployed for Indian cultural endeavours as against the mainstream startups.

One of the limitations of the technology is its **cost**. A large part of the cost is borne out of the expensive hardware equipment, mostly imported. For example, a LIDAR 3D Scanner is priced at ₹10,00,000-₹17,00,000, VR HMDs are in the range of ₹50,000-₹2,00,000. There are HMDs that are manufactured by Indian Startups but they can't afford to bring their price down owing to high manufacturing costs with low margins. The PLI scheme from the Govt of India has helped usher in the hardware manufacturing startups but more needs to be done, before Indian startups replace the industry leaders, be it from USA or from China. Hardware startups in the realm of 3D scanning, 3D printing and VR/AR could be given greater concessions to manufacture at scale and create world-class hardware in the years ahead. Deeper research and reporting need to be undertaken in this regard to understand the industry's needs and pain points and address the same.

There is great scope in harnessing HeriTech for the younger generation but it requires a multi-pronged approach with focused actions across outlined areas, spanning from cultural awareness to technology investments and industry development. This is a greenfield space which needs to be harnessed and sustained as a national mission, to catapult India on to the world stage as the strongest soft power in the world.

CONCLUSION

Technologies today are mature and scalable, unlike technologies of 80s or 90s when 3D modeling and Metaverse had failed. It is, therefore, an invaluable opportunity for technologists, scholars, researchers, academicians and Govt authorities to come together and help reclaim our ancient knowledge repositories, our heritage, and re-anoint Bharat and its civilizational grandeur as the *Vishwaguru*.

DEFINITIONS OF KEY TERMS USED

Āgamashāstra is a Sanskrit term that describes the manual for worship, temple building and rituals, among other things, within the traditions of Hinduism, Buddhism and Jainism

Ambisonic Sound is a high-fidelity audio system that reproduces the directional and acoustic properties of recorded sound using two or more channels

Archaeoacoustics is a sub-field of archaeology and acoustics which studies the relationship between people and sound throughout history. It is an interdisciplinary field with methodological contributions from acoustics, archaeology, and computer simulation

Garbagrihā is the sanctum sanctorum of a temple

HMD (Head-Mounted Display) is worn on the head and has a small display optic in front of one (monocular HMD) or each eye (binocular HMD)

Kalā is the Sanskrit term for skilled crafts like fine arts and performing arts

LIDAR (Light Detection and Ranging) is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth

Panchāṅg is a Hindu calendar and almanac, which follows traditional units of Hindu timekeeping, and presents important dates and their calculations in a tabulated form

Point-Cloud is a set of data points in a 3D coordinate system—commonly known as the XYZ axes. Each point represents a single spatial measurement on the object's surface. Taken together, a point cloud represents the entire external surface of an object

Shāstra is the Sanskrit term for precept, rules, manual, compendium or book or treatise in a general sense

Sthāpathyaveda is an ancient system that involves the connection between people and the buildings in which they live and work

Sthapathi is a Sanskrit term that refers to an architect, sculptor, metal worker or a master craftsman

Vedapātha is the recitation of the *Veda*. There are multiple variants of *Vedapātha* like *Ghanapātha* which have ensured lossless transfer of oral knowledge across generations for millennia

Vidyā is the Sanskrit term for knowledge.

Vishwaguru is a Sanskrit phrase and idea which translates to world leader or global guide or teacher

Vishwakarmā is the deified ancient architect. Members within his lineage are referred to as *Vishwakarmā*, to this day

Brief Profile of the Author:

Ajit Padmanabh is the Founder and CEO at Who VR. He is a passionate techie with over 2 decades of experience in various technologies including AI and was with Infosys for 18 years. His startup, Who VR is one of the 3 companies in the world focused on Digital Heritage, using technologies like VR, AR to recreate our Heritage. They are on a mission to put India on the world stage in terms of tourism, arts and culture and expose the world to the richness and depth of our ancient architecture, ancient sciences & arts and metaphysics.

Ajit is also a TEDx speaker and has given numerous talks on HeriTech across IITs, IIITs and other colleges across the country. He is also a panelist on Republic Digital.

He is a self-taught guitarist and composer. Known as World Void Web, he creates symphonic rock instrumental music with spiritual-historical themes and has released two albums “Think Void” and “Voider Perspectives”, available on all music platforms.

Statements and Declaration: I declare that I have no conflict of interest with my places of employment or anybody else in publishing this paper. Some sections of this paper (including a couple of photographs) also appear in one of my previous articles which has been published in a book titled "Glimpses of Art and Archaeology of India and South Asia Felicitation Volume of Padmashri K K Muhammed" (<https://www.ibpbooks.in/glimpses-of-art-and-archaeology-of-india-and-south-asia-felicitation-volume-of-padmashri-k-k-muhammed/p/62514>). I hold the copyright to that article. I also warrant that the manuscript is my original work and does not infringe on any rights of third parties.

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From Psychoanalysis to Metacognitive Science: A Triadic Framework for Consciousness and Integrative Inquiry

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Abstract:

This paper introduces the "*Tri-Pada*" principle, a conceptual framework designed to synthesize insights from psychoanalysis, Indian philosophical systems (*Vedānta*, *Sāṅkhya*, *Yoga*), and Buddhist epistemology with contemporary theories of scientific metacognition. Addressing the epistemological challenge posed by non-falsifiable foundational principles within science, this work explores the potential integration of analogous universal principles from historically rich intellectual traditions, particularly Indian Knowledge Systems, into mainstream scientific discourse. The *Tri-Pada* model amalgamates various triadic constructs—including Freudian psychodynamics (Id, Ego, Superego), *Vedānta* ontology (*Sthūla Śarīra*, *Sūkṣma Śarīra*, *Kāraṇa Śarīra*), Buddhist *Trikāya* doctrine (*Dharmakāya*, *Sambhogakāya*, *Nirmāṇakāya*), *Vedānta* states of consciousness (*Jāgrit*, *Svapna*, *Suṣupti*), and the *Sāṅkhya* theory of *Guṇa* (*Sattva*, *Rajas*, *Tamas*)—arguing for their reinterpretation beyond mystical connotations towards a framework grounded in observable cognitive, behavioral, and phenomenological patterns. A central element of this synthesis is the "Observer Mode," conceptualized as a transcendental metacognitive process derived from states such as *Turiya*, *Bodhisattva*-hood, and *Purusha*. Functioning as an epistemic tool, Observer Mode facilitates detached self-observation of cognitive processes, bridging subjective experience and objective empirical scrutiny. The paper critically examines parallels and divergences between Western psychoanalytic thought and Eastern introspective traditions, advocating for the cultivation of self-directed metacognitive awareness as emphasized in *Vedānta* and Buddhism. Ultimately, this work proposes a paradigm shift towards a "Spirituos-Scientific" domain, advocating for the integration of rigorous empirical methodologies with systematic introspective practices. It posits that recognizing introspection as a critical scientific asset can lead to a more holistic and comprehensive understanding of human consciousness.

Keywords: Indian Knowledge Systems, *Tri-Pada*, Psychoanalysis, Metacognition

INTRODUCTION

(For the benefit of the readers, definitions of key terms have been provided at the end of the paper)

Epistemological Boundaries of Science

Science, as a discipline, is fundamentally rooted in the principle of falsifiability, ensuring that hypotheses and theories are testable and subject to potential refutation (Popper, 1959). Paradoxically, certain foundational principles within science, such as the laws of thermodynamics, the law of conservation, and the principle of relativity, are inherently non-falsifiable (Hawking, 1996). These universal laws, though derived from empirical observation, function as axiomatic frameworks within which falsifiable hypotheses are formulated. This duality necessitates a deeper examination of the epistemological boundaries of scientific inquiry and raises pertinent questions regarding the existence of analogous universal principles in less-explored intellectual traditions.

A particularly compelling area of inquiry involves examining disciplines exhibiting proto-scientific characteristics—traditions that, while not conforming strictly to the modern scientific method, offer structured and experiential insights into human cognition and existence.

Integrating Eastern Thought into Scientific Inquiry

Among these are Indian philosophical traditions, which offer sophisticated conceptualizations of causality, self, and consciousness. For example, the concept of causality, as expounded in Indian philosophy, aligns closely with modern statistical inference. The Buddhist doctrine of *Pratītyasamutpāda* (dependent origination) posits that suffering (*dukkha*) arises in correlation with other determining factors (Gethin, 1998), a notion interpretable through the lens of statistical correlation and causation.

This discussion does not seek to challenge or critique established scientific principles with the intent of supplanting them. Rather, it advocates for a paradigm shift emphasizing the practical application of foundational philosophical insights to address contemporary issues, such as mental health, without succumbing to dogmatism. A pertinent example is found in the field of psychology, where psychoanalysis has historically been criticized for its lack of strict falsifiability (Kakar, 1982). Despite this, extensive meta-analytical studies underscore its therapeutic efficacy, demonstrating its continued relevance. This suggests that, akin to physics, psychology may benefit from overarching principles that, while not strictly falsifiable, offer a coherent and universal framework for understanding human behavior and consciousness.

Introduction of *Tri-Pada*

A synthesis of diverse intellectual traditions yields a triadic framework known as the *Tri-Pada* principle—a conceptual model of mind-body interaction and consciousness integrating insights from multiple domains, including psychoanalysis, Indian philosophy, and Buddhist epistemology. The term *Tri-Pada* comes from Sanskrit and translates to 'three steps.' It serves as a bridge between philosophical inquiry, spiritual traditions, and modern psychological theories.

This paper argues against the outright dismissal of complex, historically rich frameworks as mere mysticism and instead advocates for their reinterpretation through the lens of scientific metacognition. This approach fosters novel avenues for empirical research while preserving the depth of these intellectual traditions. The central objective of this paper is to establish *Tri-Pada* as a conceptual foundation that, rather than being mystical, is firmly grounded in observable cognitive, behavioral, and phenomenological patterns.

The *Tri-Pada* model synthesizes parallels across various intellectual traditions, including:

- Freud's psychoanalytic constructs of the Id, Ego, and Superego (Freud, 1923).
- The *Vedānta* framework of *Sthūla Śarīra* (gross body), *Sūkṣma Śarīra* (subtle body), and *Kāraṇa Śarīra* (Chakrabarti, 1999).
- The Buddhist *Trikāya* doctrine, comprising *Dharmakāya*, *Sambhogakāya*, and *Nirmāṇakāya* (Williams, 2009).
- The *Vedānta* states of consciousness: *Jāgrit* (waking state), *Svapna* (dream state), and *Suṣupti* (Menon, 2005).
- The triadic interplay of *Guṇas* in *Sāṅkhya* philosophy: *Sattva* (balance), *Rajas* (activity), and *Tamas* (Sinha & Tripathi, 2013).

An essential aspect of the *Tri-Pada* framework is the notion of transcendence, referred to as the "observer mode." This raises a fundamental question: What cognitive or phenomenological process within sentient beings facilitates the observation of thought itself? By systematically integrating these archetypal structures, the *Tri-Pada* model aspires to establish a cohesive, cross-cultural framework for understanding the human psyche, thereby enhancing both metacognitive awareness and phenomenological inquiry.

SCOPE & METHODOLOGY

This paper undertakes a critical examination of the philosophical foundations, scientific feasibility, and epistemological implications of adopting *Tri-Pada* as a foundational model for future research. In doing so, it seeks to lay the groundwork for the emergence of a systematic "Spirituo-Scientific" domain that can synthesize spirituality and science.

While the *Tri-Pada* framework is conceptual and cross-disciplinary, it lends itself to empirical investigation through multiple methodological avenues. For instance, the component may be explored through neuroimaging studies on mindfulness and meta-awareness, particularly using fMRI to track activation in brain regions associated with self-regulation and attentional control. The triadic elements of the model—such as the Gross, Subtle, and Causal bodies—could be operationalized in phenomenological interviews to assess subjective experiences during meditative or therapeutic states. Likewise, parallels with Freud's tripartite psyche suggest applications in psychodynamic psychotherapy, where awareness of egoic structures and their

transcendence through insight can be studied through both qualitative analysis and therapeutic outcome metrics.

By proposing an integrative principle, this paper endeavors to illuminate an alternative epistemic pathway that synthesizes science, spirituality, and human experience into a universal framework, fostering the highest level of metacognitive refinement. This paper is intended for an interdisciplinary audience spanning psychology, philosophy, traditions, cognitive science, and contemplative studies. While some foundational concepts are drawn from psychoanalysis and Indian/Buddhist metaphysics, the goal is to present them in a way that is accessible and relevant to empirical researchers, clinicians, and scholars of consciousness alike. Readers unfamiliar with any one tradition are encouraged to approach the material through the lens of integrative inquiry.

FREUDIAN PSYCHOANALYSIS: ID, EGO, SUPEREGO

Sigmund Freud remains one of the most influential yet contentious figures in the modern study of the human mind. His groundbreaking work on the unconscious has profoundly shaped the trajectory of psychology and psychoanalysis, establishing a framework that continues to inspire contemporary inquiry. Freud's conceptualization of the unconscious mind, along with his methodological innovations such as free association and dream analysis, has offered significant insights into the intricacies of human thought and behavior (Freud, 1900).

Freud's seminal work, *The Interpretation of Dreams* (1900), underscores the symbolic nature of dreams, which he regarded as the "royal road to the unconscious." His interpretation of dream symbols, such as the snake representing repressed sexual desires, illustrates his theory that unconscious material often manifests through metaphor and displacement. This interpretation, however, has been critiqued for its cultural specificity. For instance, while Judeo-Christian traditions frequently associate the snake with temptation and sin (e.g., the story of Adam and Eve), in Indian traditions, the snake (*Nāga*) is revered as a deity symbolizing protection, wisdom, and fertility. This contrast highlights the extent to which cultural frameworks shape both unconscious symbolism and the interpretive lenses through which they are understood.

Freud's structural model of the psyche—the Id, Ego, and Superego—offers a foundational perspective on the dynamics of human consciousness. The Id, representing primal instincts and desires, operates on the pleasure principle, seeking immediate gratification. The Ego, functioning as a mediator, engages with reality to balance the demands of the Id and the moral imperatives of the Superego. The Superego internalizes societal norms and ethical principles, exerting influence over an individual's sense of morality and self-regulation (Freud, 1923). This dynamic interplay between the three structures provides a compelling explanation for psychological conflicts, defense mechanisms, and behavioral patterns.

While Freud's theoretical contributions have been instrumental in the development of clinical psychology, psychoanalysis has been criticized for its emphasis on therapist-driven interpretation. This reliance on an external analyst to decode unconscious material raises questions about individual agency in psychological self-discovery. One notable limitation is the lack of an inherent mechanism within Freudian psychoanalysis for fostering metacognition—the ability to understand and regulate one's own cognitive processes (Mitra, 2020). This critique invites an important consideration: How can individuals cultivate an autonomous, self-reflective approach to understanding their psyche and achieving psychological well-being?

Previous efforts to bridge psychoanalysis and Eastern thought can be found in fields such as transpersonal psychology, which integrates spirituality with therapeutic practice, and in Jungian psychology, which interprets Eastern concepts like mandalas, archetypes, and individuation through a psycho-symbolic lens (Jung, 1959). While these approaches opened important pathways, they often remained either symbolic or therapeutically oriented without developing a unified metacognitive model. The *Tri-Pada* framework proposed in this paper builds upon these foundations by offering a structured, cross-cultural model that integrates not just symbolic parallels, but cognitive, behavioral, and phenomenological dimensions into a coherent system. In doing so, it seeks to move beyond comparative insight toward a testable and operational metatheory of consciousness.

Eastern philosophical traditions provide an alternative perspective that emphasizes self-directed introspection and transformation. Schools of thought rooted in *Vedānta*, Buddhism, and *Yoga* advocate for inner discipline through practices such as meditation, mindfulness, and self-inquiry. The *Vedānta* concept of *Antaranga Sādhana* (inner discipline) encourages individuals to engage in deep self-exploration to transcend the limitations of the ego and realize their true self (Menon, 2005). Similarly, Buddhist practices such as *Vipāsanā* meditation promote direct awareness of mental processes, allowing individuals to observe and ultimately transcend conditioned responses (Williams, 2009). These traditions prioritize cultivating self-awareness without reliance on an external authority, positioning introspection as an intrinsic psychological tool rather than an externally mediated process.

Despite their depth and sophistication, these traditions have historically been constrained by the *Guru-Shishya* (teacher-disciple) framework, which often restricted access to esoteric knowledge. However, the increasing academic recognition of Indian Knowledge Systems (IKS) presents an opportunity to integrate these philosophical insights into contemporary psychological discourse. By treating IKS as an evolved, structured adaptation of the traditional *Guru-Shishya* model, modern psychology can develop new frameworks for understanding consciousness, fostering metacognition, and achieving self-sustained mental well-being.

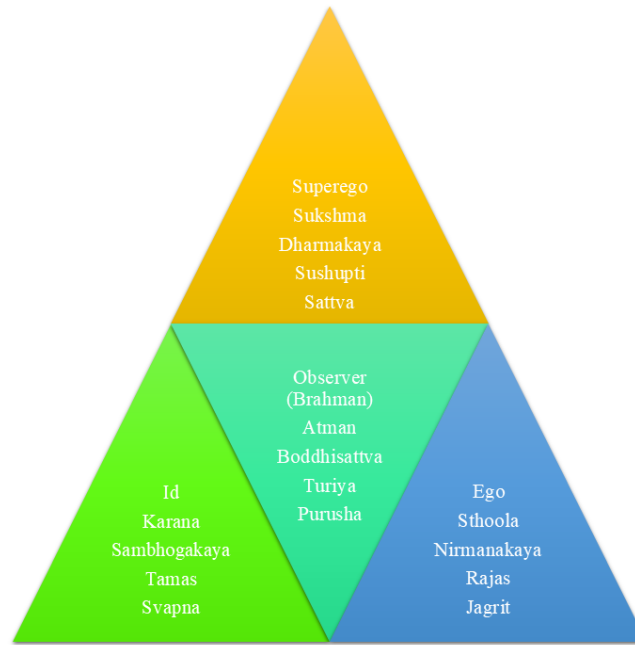


Figure 1: Representation of *Tri-Pada* model of human psyche

TRI-ŚARĪRA DOCTRINE OF INDIC PHILOSOPHY: STHŪLA ŚARĪRA, SŪKṢMA ŚARĪRA, KĀRAṆA ŚARĪRA

The concept of *Tri-Śarīra* (three bodies) is the fundamental framework rooted in Indian Knowledge Systems (IKS), providing a holistic understanding of human existence. It delineates three interrelated layers of being: the *Sthūla Śarīra* (gross body), *Sūkṣma Śarīra* (subtle body), and *Kāraṇa Śarīra* (causal body). This framework is not merely a metaphysical construct but serves as an epistemological and ontological tool for advancing metacognition, offering a nuanced perspective on consciousness, behavior, and human potential. It resonates with and, in certain respects, extends the paradigms of Western psychology while also addressing its limitations.

Sthūla Śarīra (Gross Body): The Material Basis of Experience

स्थूलशरीरं किम्? पञ्चीकृतपञ्चमहाभूतैः कृतं सत्कर्मजन्यं सुखदुःखादिभोगायतनं शरीरम्।
अस्ति जायते वर्धते विपरिणमते अपक्षीयते विनश्यतीति षड्विकारवदेतत् स्थूलशरीरम्।

Translation: "What is the *Sthūla Śarīra*? It is the body made of the five grossified elements (*pancha-mahabhutas*) that serves as the locus for experiencing pleasure and pain due to manifested deeds (*sat-karma*). It undergoes six transformations (*shadvikara*): existence (*asti*), birth (*jayate*), growth (*vardhate*), transformation (*viparinamate*), decay (*apakshiyate*), and destruction (*vinashyati*)."

The *Sthūla Śarīra* underscores the transient and mutable nature of the physical body. The detailed exegesis of Shankaracharya emphasizes its impermanence, aligning with modern

biological understandings of aging and cellular degeneration. However, unlike purely biological perspectives, this framework recognizes the body as both an instrument of sensory experience and a foundation for higher-order introspection.

Western psychological models, notably Freud's structural theory of the psyche, often underemphasize the role of the body in shaping cognition and emotional states. Freud's model—comprising the Id, Ego, and Superego—primarily focuses on intrapsychic dynamics rather than the physiological basis of experience (Freud, 1923/1990). However, contemporary neuropsychological research, including Damasio's (1994) somatic marker hypothesis, highlights the integration of bodily states in decision-making and emotional regulation, an idea that aligns closely with the holistic understanding of the *Sthūla Śarīra*.

Metacognitive practices related to the *Sthūla Śarīra* involve acknowledging the impermanence of bodily experiences and their influence on cognition. This aligns with mindfulness-based stress reduction (MBSR), a framework pioneered by Kabat-Zinn (1990), which emphasizes bodily awareness for emotional regulation.

***Sūkṣma Śarīra* (Subtle Body): The Cognitive and Energetic Interface**

सूक्ष्मशरीरं किम्? अपञ्चीकृतपञ्चमहाभूतैः कृतं सत्कर्मजन्यं सुखदुःखादिभोगसाधनं
पञ्चज्ञानेन्द्रियाणि पञ्चकर्मेन्द्रियाणि पञ्चप्राणादयः मनश्चैकं बुद्धिश्चैका एवं सप्तदशाकलाभिः
सह यत्तिष्ठति तत्सूक्ष्मशरीरम्।

Translation: "What is the *Sūkṣma Śarīra*? It is the body made of the five subtle elements (*tanmātra*), arising from virtuous deeds (*sat-karma*), and serves as the means for experiencing pleasure and pain. It comprises the five sense organs (*jnānendriyā*), five organs of action (*karmendriyā*), five vital airs (*prāna*), mind (*manas*), and intellect (*buddhi*), totalling 17 components."

The *Sūkṣma Śarīra* bridges the physical and metaphysical, encompassing cognitive, emotional, and energetic dimensions. It parallels Freud's unconscious and preconscious constructs but also incorporates elements akin to Jung's concept of the collective unconscious, which postulates universal archetypal patterns across human cultures (Jung, 1968).

A critical metacognitive insight from the *Sūkṣma Śarīra* is the recognition of subtle mental patterns and energies (*prāna*) that shape human experience. This aligns with cognitive-behavioral therapy (CBT), which identifies and restructures maladaptive cognitive patterns (Beck, 1976). Furthermore, practices such as *prānāyāma* (breath control) and *dhyāna* (meditation) are instrumental in regulating these patterns, enhancing self-awareness and emotional intelligence.

Daniel Siegel's (2012) work on interpersonal neurobiology further supports this framework by elucidating the brain-body connection, demonstrating how embodied cognition impacts

psychological functioning. This perspective reinforces the *Sūkṣma Śarīra*'s role as an intermediary between sensory inputs and deeper cognitive structures.

***Kāraṇa Śarīra* (Causal Body): The Foundation of Human Existence**

कारणशरीरं किम्? अनिर्वच्यानाद्यविद्यारूपं शरीरद्वयस्य कारणमात्रं सत्स्वरूपाऽज्ञानं
निर्विकल्पकरूपं यदस्ति तत्कारणशरीरम्।

Translation: "What is the *Kāraṇa Śarīra*? It is the indescribable (*anirvāchya*) form of primal ignorance (*avidyā*), serving as the cause of the other two bodies. It is the essence of being (*sat*) in a state of ignorance, devoid of distinctions (*nirvikalpa*)."

The *Kāraṇa Śarīra* represents the deepest substratum of existence, housing latent tendencies (*samskāra*) and karmic imprints. This conceptualization finds a distant parallel in Jung's individuation process, which seeks to integrate unconscious elements into conscious awareness (Jung, 1959). However, the *Kāraṇa Śarīra* extends beyond psychological integration to encompass spiritual realization and liberation (*moksha*).

Metacognition at this level entails transcending conditioned perception and self-limiting constructs, a pursuit emphasized in *Advaita Vedānta*'s self-inquiry (*ātma-vichāra*) and Buddhist mindfulness techniques, which aim to dissolve dualistic thinking and reveal the non-dual nature of consciousness. Viktor Frankl's (1959) logotherapy, which underscores meaning-seeking as a fundamental human drive, similarly aligns with the causal body's role in guiding spiritual evolution.

TRIKĀYA DOCTRINE OF BUDDHISM: DHARMAKĀYA, SAMBHOGAKĀYA, NIRMĀṆAKĀYA

The *Trikāya* Doctrine in Buddhism articulates three dimensions of the Buddha's being: *Dharmakāya* (truth body), *Sambhogakāya* (enjoyment body), and *Nirmāṇakāya* (manifestation body). These levels represent distinct but interconnected facets of enlightenment, offering insights into the dynamics of consciousness, morality, and self-realization. While these ideas emerge from Buddhist metaphysics, they resonate with certain psychological and philosophical frameworks, such as Freud's structural model of the psyche and Hinduism's *Tri-Śarīra* (three-body) doctrine. By exploring these intersections, we can identify valuable pathways for integrating spiritual and scientific perspectives on consciousness (Williams, 2009).

The *Dharmakāya*, often described as the "truth body," is the embodiment of ultimate reality and pure morality. It signifies the unconditioned, formless essence of the Buddha, transcending dualistic perceptions and representing universal wisdom. Freud's Superego offers a structural parallel to the *Dharmakāya* in its role as a moral compass (Rosenfeld, 1962). However, there is a significant divergence in their underlying principles. While Freud's Superego is shaped by

societal norms and cultural conditioning, often producing conflict and repression within the psyche, the *Dharmakāya* operates as a state of absolute morality—universal and unconditioned. This highlights a key distinction: Freud's Superego addresses morality in the context of personal and cultural dynamics, whereas the *Dharmakāya* embodies a transcendent, universally applicable ethical consciousness (Lusthaus, 2002).

The *Sambhogakāya*, or "enjoyment body," represents the Buddha's capacity to engage with others through the fulfillment of spiritual and existential desires. It is described as the dimension in which enlightened beings, such as *Bodhisattvas*, experience and share the bliss of enlightenment. From a psychological perspective, this aligns with the function of Freud's Id, which is driven by primal desires and the pursuit of satisfaction (Freud, 1923/1961). However, while the Id is often associated with unconscious and instinctual drives, the *Sambhogakāya* transcends these limitations by transforming desire into a harmonious expression of fulfillment. It bridges the personal and the universal, enabling a compassionate engagement with the world that fosters metacognitive awareness of one's deeper motivations and their integration into higher spiritual goals (Gethin, 1998).

The *Nirmāṇakāya*, or "manifestation body," is the Buddha's tangible form in the physical world. This body allows the Buddha to interact with beings in their own realm of existence, serving as a direct means of guiding them toward enlightenment. This aspect can be likened to Freud's Ego, which functions as the mediator between the external world and the internal demands of the psyche (Freud, 1923/1961). However, Freud's Ego primarily navigates the complexities of the individual's immediate environment and personal reality, often with a focus on psychological survival and adaptation. In contrast, the represents a fully realized ego that operates not for self-preservation but for the benefit of others, embodying a form of altruistic agency that is deeply rooted in metacognitive and moral clarity (Harvey, 2013).

The *Trikāya* doctrine and the *Tri-Śarīra* framework offer unique perspectives on human existence and consciousness, with both differences *Nirmāṇakāya* and complements in their philosophical treatment. In Buddhism, the three kayas—*Dharmakāya* (truth body), *Sambhogakāya* (enjoyment body), and *Nirmāṇakāya* (manifestation body)—are seen as enlightened states attained through the realization of pure consciousness. In contrast, Hinduism's three *Śarīra* — *Sthūla Śarīra* (gross body), *Sūkṣma Śarīra* (subtle body), and *Kāraṇa Śarīra* (causal body)—are seen as temporary constructs to be transcended, with only the *Ātman* as the ultimate and eternal reality (Dasgupta, 1922).

In this synthesis, *Nirmāṇakāya* aligns with the *Sthūla Śarīra*, as both represent the physical form. In Buddhism, the *Nirmāṇakāya* is the Buddha's physical manifestation, engaging compassionately in the world to guide others toward liberation. However, in Hinduism, the *Sthūla Śarīra* is regarded as transient and subject to the cycle of birth, decay, and death. It is something to be comprehended and ultimately transcended, as it is a temporary vehicle for experiencing the material world. Despite this difference, both concepts recognize the

importance of the physical realm in spiritual practice, whether through compassionate action or as a starting point for self-inquiry (Krishnamurti, 1983).

Sambhogakāya, the enjoyment body, represents the fulfillment of desires in Buddhism, not in a hedonistic sense but as an enlightened engagement with bliss and wisdom. It aligns with the *Kāraṇa Śarīra*, which houses latent impressions (*samskāra*) and is the cause of both suffering and liberation. While Buddhism elevates the *Sambhogakāya* as a transformative state of spiritual enjoyment, Hinduism emphasizes transcending the *Kāraṇa Śarīra*, dissolving its karmic bonds to achieve liberation (*moksha*) (Olivelle, 1998). The complementarity here lies in their shared focus on the deeper causality of human experience, even as their approaches diverge.

Dharmakāya, the truth body, aligns with the *Sūkṣma Śarīra*, as both represent a connection to higher consciousness. The *Dharmakāya* embodies pure morality and unconditioned reality, the ultimate realization of Buddha-nature. Similarly, the *Sūkṣma Śarīra* connects the physical and causal realms, encompassing the mind, intellect, and subtle energies. However, while the *Dharmakāya* is an enlightened state in itself, the *Sūkṣma Śarīra* is still a layer to be transcended in Hinduism. The *Ātman*, as the eternal self, encompasses and surpasses all the *Śarīras*, pointing to a fundamental divergence between the two systems (Flood, 1996).

STATES OF CONSCIOUSNESS OF *VEDĀNTA*: *JĀGRIT, SVAPNA, SUṢUPTI*

The *Vedānta* philosophy offers a profound framework for understanding human consciousness through three fundamental states: *Jāgrit* (wakefulness), *Svapna* (dreaming), and *Suṣupti* (deep sleep). These states delineate different levels of human experience and cognition, integrating ancient spiritual insights with modern psychological paradigms.

In *Vedānta* philosophy, *Jāgrit* refers to the waking state, in which the mind actively engages with the external world. This state is closely tied to the ego, as the self identifies most strongly with sensory and cognitive experiences. From a psychological perspective, this aligns with Freud's concept of the Ego, which mediates between the individual's desires and external reality (Freud, 1923). However, *Vedānta* underscores the necessity of metacognition—conscious awareness of one's thoughts and actions—to transcend the ego's limitations. By critically evaluating the self-identity derived from external interactions, an individual may begin to perceive the *Jāgrit* state as a construct rather than an ultimate reality. While the ego facilitates survival and social functioning, *Vedānta* posits that it is a surface-level identity to be transcended in the pursuit of higher consciousness.

The *Svapna* state corresponds to the dream realm, where the mind turns inward and engages with subconscious imagery, desires, and impressions. In Freudian theory, this state is where

the Id, the reservoir of primal instincts and unconscious drives, operates most freely (Freud, 1900). Both *Vedānta* and Freudian perspectives recognize dreams as reflections of deeper aspects of the psyche, often revealing latent thoughts and unresolved emotions. However, *Vedānta* extends beyond Freud's notion of repressed desires, viewing the *Svapna* state as an opportunity for self-reflection. Through conscious observation and interpretation of symbolic dream elements, an individual can gain awareness of subconscious influences and karmic impressions (*samskāra*) that shape identity (Rama, Ballentine, & Ajaya, 1976). Transcending this state is not merely about decoding these influences but also about recognizing the limitations of the Id and progressing toward self-awareness.

The *Suṣupti* state, or deep sleep, is a phase in which conscious mental activity ceases entirely. In Freudian terms, the Superego—representing internalized moral and social constructs—operates actively in waking and dreaming states but becomes dormant in deep sleep (Freud, 1923). *Vedānta*, however, interprets *Suṣupti* as more than a mere physiological necessity; it is considered a temporary dissolution of ego-driven consciousness, offering a glimpse into universal awareness (Nikhilananda, 1936). Modern neuroscience correlates deep sleep with essential cognitive functions such as memory consolidation (Diekelmann & Born, 2010), but *Vedānta* emphasizes its spiritual dimension. The *Sushupti* state serves as an experiential bridge, revealing that even in the absence of ego and Id, a substratum of moral awareness persists.

Vedānta introduces *Turiya*, a state beyond wakefulness, dreaming, and deep sleep. *Turiya* is not merely an additional phase of consciousness but the foundational reality underlying all other states. It aligns with concepts found in Buddhist philosophy, such as the realization of Buddhahood, and in Hindu thought as the recognition of the *Ātman*, or true self (Nikhilananda, 1936). In this state, one fully transcends the constructs of the ego, Id, and Superego, attaining a non-dual awareness that integrates all experiences into a singular, undivided reality.

Experientially, this state can be characterized by a profound sense of non-duality (*advaita*), silence of mental fluctuations (*chitta vritti nirodha*), and an unshakable awareness that is conscious of consciousness itself. While not ordinarily accessible through sensory or discursive cognition, practices like *Ātma-Vichāra* (self-inquiry) and meditative absorption (*dhyāna*) are traditional pathways for accessing this state. These practices direct attention inward, stripping away identification with body, thought, and ego, until only the witnessing awareness remains. In this sense, *Turiya* is not attained but revealed, as the ever-present Observer that is otherwise obscured by mental conditioning.

SĀṆKHYA & YOGA PHILOSOPHYS' THREE GUṆA: SATTVA, RAJAS, TAMAS

In the deeper layers of the triadic framework of Indian philosophy, the concept of the three *Guṇa*—*Sattva*, *Rajas* and *Tamas*—offers profound insight into the dynamics of human behavior, cognition, and existence. These *Guṇa*, rooted in the *Sāṅkhya* philosophy, function as

the fundamental qualities that govern all of nature (*Prakriti*), including the human mind and body. They are not merely psychological attributes but also metaphysical principles, presenting a holistic approach to understanding existence (Rao, 2011).

Sattva, characterized by clarity, balance, and harmony, closely aligns with the Superego in Freudian psychology. Just as the Superego embodies moral values and ideals, *Sattva* represents the higher virtues of the mind—purity, wisdom, and the pursuit of truth (Dasgupta, 1992). An individual dominated by *Sattva* is inclined toward ethical behavior, selflessness, and spiritual growth.

In modern psychological terms, *Sattva* functions as an internalized moral compass, guiding individuals toward altruistic actions and higher aspirations. It resonates with psychological constructs such as mindfulness and ethical reasoning, both of which cultivate inner peace and clarity (Davidson & Dahl, 2018). However, unlike the Superego, which is shaped by societal conditioning, *Sattva* is believed to emerge from a deeper connection with universal truth, transcending cultural and personal biases.

Rajas, defined by activity, desire, and dynamism, corresponds to the Ego in its role of navigating day-to-day life. The Ego mediates between the internal drives of the Id and the external demands of reality, much like *Rajas* propels individuals to engage with the world (Kakar, 1982). *Rajas* is the force behind ambition, competition, and effort, but it is also the source of restlessness and attachment.

While *Rajas* is essential for functioning and progress, its dominance can lead to stress, conflict, and over-identification with worldly pursuits. *Vedānta* and *Sāṅkhya* traditions encourage individuals to balance *Rajas* by channeling its energy toward purposeful action rather than unregulated desire (Prabhupada, 1972). This perspective aligns with modern psychological approaches that emphasize goal-setting and emotional regulation to maintain equilibrium in one's life (Ryan & Deci, 2000).

Tamas, associated with inertia, ignorance, and darkness, mirrors the Id, which represents primal instincts and unconscious drives (Freud, 1961). *Tamas* manifests as stagnation, lethargy, and indulgence, reflecting the Id's instinctual, often unregulated impulses.

However, while Freud's Id is primarily a psychological construct, *Tamas* encompasses both physical and metaphysical aspects. It is the force that resists change and binds individuals to material limitations (Rao, 2011). Overcoming *Tamas* involves developing awareness and discipline, akin to psychological efforts aimed at bringing unconscious drives into conscious awareness through self-reflection and intentionality (Jung, 1968).

The *Sāṅkhya* philosophy, within which the concept of *Guṇa* originates, extends beyond psychology to encompass the metaphysics of existence. Unlike Western psychological models, which primarily analyze the mind, *Sāṅkhya* integrates the physical body and its connection to

the cosmos. The *Guṇa* are not merely qualities of the mind but are inherent in the *Panchabhūta* (five elements: earth, water, fire, air, and ether), which constitute both the human body and the material world (Hiriyanna, 1949).

For example, *Tamas* corresponds to denser elements such as earth and water, symbolizing inertia and stability. *Rajas* aligns with fire and air, representing activity and transformation, while *Sattva* resonates with ether, signifying clarity and transcendence. This integration of psychological and physical principles highlights the deeply interconnected nature of consciousness, matter, and existence in *Sāṅkhya* thought.

While Freud's model of the psyche aims to explain human behavior in therapeutic contexts, the *Sāṅkhya* framework extends this inquiry to include the physics of the body and the universe. This dual psychological-metaphysical inquiry seeks to uncover the interplay between individual consciousness and cosmic principles, presenting a holistic framework for self-realization (Dasgupta, 1922).

The ultimate goal in *Sāṅkhya* and *Vedānta* traditions is to transcend the *Guṇa* and realize *Purusha*—pure consciousness or the true self. This transcendence is comparable to the concept of self-actualization in modern psychology, where an individual moves beyond basic drives and societal conditioning to achieve their highest potential (Maslow, 1971).

Transcending *Tamas* requires overcoming ignorance and inertia through knowledge and self-discipline. Mastery over *Rajas* involves detaching from desires and channeling energy toward selfless action. Finally, transcending *Sattva*—despite its association with virtue—requires recognizing that even moral excellence is a construct of the material world. Only by rising above all three *Guṇa* can one attain liberation (*moksha*) and unity with the higher self (Prabhupada, 1972).

OBSERVER MODE: A PARADIGM FOR SCIENTIFIC METACOGNITION

Observer represents a crucial transcendental function within the broader framework of metacognition. It refers to the cognitive capacity to observe and reflect upon one's own thoughts, emotions, and behavioral impulses as distinct phenomena. This mode directly correlates with self-awareness—the ability to recognize oneself as an agent within experience—and meta-awareness, which involves monitoring the contents of consciousness itself (e.g., "I notice that I am feeling anxious" rather than just *being* anxious).

It is a structured stance of the mind that allows for detached observation, enabling an individual to deconstruct automatic reactions and habitual thought patterns. For example, during a moment of anger, a person in a mode of observation might notice the physiological arousal (e.g., clenched fists), the mental narrative ("This is unfair"), and the impulse to react. Instead of being swept away by these processes, observation allows one to pause, label the experience,

and choose a conscious response. This moment of reflective distance is what distinguishes a person who observes subtle mind related processes from ordinary self-awareness.

The ideas of *Turiya/Bodhisattva/Purusha* state represent similar concept i.e. metacognition in a broader systematic way. Hence, this state can be named as ‘Observer mode’. The concept of Observer Mode represents a crucial transcendental process within the broader framework of metacognition, wherein an individual attains the capacity to observe and reflect upon their own cognitive processes as discrete phenomena. This self-referential stance is not merely an abstract state of consciousness; rather, it functions as an epistemic tool, enabling the practitioner to dissociate from immediate thought patterns and engage in a systematic, objective evaluation of mental operations. The cultivation of Observer Mode, therefore, emerges as a foundational requirement for advancing scientific inquiry into the dynamics of consciousness and cognition.

Central to this discourse is the recognition that traditional scientific methodologies often prioritize external observation and measurement while relegating introspective insight to the margins of inquiry. In contrast, Observer Mode encapsulates an integrative approach that synthesizes internal subjective awareness with external empirical scrutiny. This dual perspective is reminiscent of the dialectical interplay between the idiosyncratic experiences of subjectivity and the objective demands of scientific falsifiability—a tension that has long been acknowledged in both Western scientific paradigms (Popper, 1959) and Eastern contemplative traditions (Menon, 2005).

From a neurocognitive standpoint, the emergence of Observer Mode can be understood as an evolution of metacognitive regulation. Recent advances in interpersonal neurobiology suggest that the ability to adopt an observer stance is underpinned by complex neural circuits that mediate self-awareness and executive control (Siegel, 2012). This cerebral architecture enables an individual to effectively decouple from immediate emotional and cognitive reactivity, thereby fostering a reflective state that is essential for adaptive learning and the reassessment of entrenched behavioral patterns. In this respect, Observer Mode functions analogously to the concept of mindfulness as operationalized in contemporary cognitive-behavioral therapies and stress reduction protocols (Kabat-Zinn, 1990).

Philosophically, the integration of Observer Mode into scientific metacognition extends the dialogue between ancient epistemologies and modern cognitive science. Eastern philosophies, particularly those rooted in *Vedānta* and Buddhist traditions, have long posited that self-observation is a transformative practice that transcends mere sensory experience. The introspective methodologies of Vipassana meditation and *Ātma-Vichāra* (self-inquiry) illustrate how disciplined introspection can yield insights into the impermanent nature of thought and the constructed nature of the self (Williams, 2009). I argue that, a systematic approach like that of science is required for achieving metacognition—drawing inference from these mindfulness traditions. By drawing on these diverse intellectual traditions, Observer Mode bridges the apparent dichotomy between the subjective realm of consciousness and the objective demands of empirical validation.

Moreover, the adoption of Observer Mode as a scientific paradigm necessitates a reconfiguration of traditional research methodologies. It invites a paradigm shift wherein the observer is not an inert spectator but an active participant in the generation of knowledge. This stance aligns with emerging frameworks in which the act of observation is itself a critical variable in the construction of scientific theories. Such a reorientation echoes the challenges posed by the non-falsifiability of certain universal laws and axiomatic principles, urging a re-examination of the epistemological foundations upon which modern science is built (Hawking, 1996).

In practical terms, the cultivation of Observer Mode can enhance the rigor of scientific metacognition by promoting a reflective detachment from cognitive biases and preconceptions. This self-regulatory process is instrumental in enabling researchers to critically evaluate their methodologies, thereby fostering a more robust and dynamic engagement with the scientific process. As demonstrated in various meta-analytical studies, such introspective practices can yield therapeutic benefits and contribute to the overall refinement of both personal and collective scientific inquiry (Mitra, 2020).

The theoretical construct of Observer Mode—as a metacognitive stance of detached self-awareness—also has tangible implications for therapeutic contexts, particularly in modalities such as mindfulness-based cognitive therapy, dialectical behavior therapy (DBT), and psychodynamic treatment. Within mindfulness practices, Observer Mode closely aligns with the cultivation of non-reactive awareness, helping individuals identify and pause habitual emotional responses. In cognitive restructuring, it supports the distancing from automatic thoughts, allowing clients to reflect on cognitive distortions without immediate identification or judgment. From this perspective, Observer Mode becomes a practical scaffold for emotional regulation and insight generation.

The broader *Tri-Pada* framework can also offer therapists an integrative lens through which to understand client challenges—not merely as behavioral symptoms or unconscious drives, but as expressions of imbalances across the somatic, cognitive/emotional, and existential/identity-based levels of experience. This holistic view does not prescribe specific techniques but can guide therapeutic formulation and deepen case conceptualization, especially in multicultural or transpersonal therapy settings.

More broadly, the emphasis on metacognition within this framework speaks directly to contemporary needs in psychological practice: helping clients become more aware of their thought processes, identify patterns in their emotional responses, and cultivate the reflective distance necessary for change. As such, the *Tri-Pada*–Observer Mode synthesis offers a promising direction for integrating introspective traditions with evidence-based therapeutic work, advancing both conceptual richness and clinical utility.

In sum, Observer Mode is not simply an ancillary aspect of cognitive functioning but a pivotal mechanism for achieving a higher degree of self-awareness and metacognitive clarity. Its integration into scientific paradigms underscores the potential for a more holistic understanding of consciousness—one that embraces both the empirical and the experiential. By recognizing and harnessing the transformative power of Observer Mode, researchers can pave the way for a new era of scientific metacognition that is as rigorous as it is reflective.

CONCLUSION

The *Tri-Pada* framework synthesizes multiple triadic systems from psychoanalysis, *Vedānta*, Buddhism, and Indian philosophical psychology into a unified model of consciousness. According to this refined alignment, Freud's Superego, *Sūkṣma Śarīra* (subtle body), the *Dharmakāya* (truth body), the *Suṣupti* (deep sleep) state, and the *Sattva Guṇa* collectively represent the higher introspective and ethical dimension of being—associated with clarity, equilibrium, and moral discernment. The Id, by contrast, aligns with the *Kāraṇa Śarīra* (causal body), the *Sambhogakāya* (enjoyment body), the *Svapna* (dream) state, and the *Tamas Guṇa*—representing unconscious drives, karmic residue, and inertia. Meanwhile, Freud's Ego corresponds to the *Sthūla Śarīra* (gross body), the *Nirmāṇakāya* (manifest body), the *Jāgrit* (waking) state, and the *Rajas Guṇa*—capturing the dynamic interface between self and world, marked by activity, desire, and mediation. At the center of the model (Figure 1) lies the Observer Mode, conceptualized as the *Ātman*, *Brahman*, *Turiya*, *Purusha*, or *Bodhisattva*—a transcendental, metacognitive witnessing consciousness that integrates, regulates, and ultimately transcends the triadic structures.

In synthesizing diverse intellectual traditions, this paper has endeavored to forge a cohesive framework that bridges the domains of psychoanalysis, Eastern philosophical inquiry, and contemporary scientific metacognition. The integrative approach articulated through the *Tri-Pada* framework, and particularly through the lens of Observer Mode, underscores the necessity of transcending conventional cognitive boundaries to achieve a more holistic understanding of the human mind. This synthesis, rooted in both empirical evidence and ancient wisdom, advocates for a paradigm that recognizes introspection as not only a therapeutic tool but also a critical scientific asset.

The discourse has illuminated how foundational constructs—ranging from Freud's structural model of the psyche to *Vedānta* states of consciousness—can be reinterpreted to support a dynamic model of self-reflective inquiry. Observer Mode, as elaborated herein, emerges as a pivotal mechanism that enables individuals to critically observe and recalibrate their internal processes. This capacity for metacognitive self-regulation is vital not only for personal psychological well-being but also for advancing a scientific understanding that embraces the full spectrum of human experience. Such a reorientation challenges the traditional dichotomy between objective observation and subjective introspection, offering instead a unified approach that is both empirically rigorous and phenomenologically rich.

Ultimately, the integration of these varied perspectives invites a re-examination of long-held epistemological assumptions within modern science. By reconciling the objective methodologies of empirical research with the introspective practices inherent in ancient traditions, this paper lays the groundwork for a more comprehensive model of consciousness. Future research may benefit from further exploring these intersections, thereby fostering an enriched dialogue between scientific inquiry and the perennial quest for self-understanding.

DEFINITIONS OF KEY TERMS USED

Antaranga Sadhāna

A *Vedānta* practice of inner discipline, involving self-exploration through meditation, mindfulness, or self-inquiry to transcend ego and realize the true self.

Example: Reflecting on “Who am I?” to uncover deeper aspects of identity beyond roles or emotions.

Ātma-Vichāra

A *Vedānta* method of self-inquiry, where one questions the nature of the self to realize the eternal Atman (true self) beyond temporary mental or physical constructs.

Example: Asking, “What remains when all thoughts stop?” to discover a core sense of awareness.

Ego

In Freudian psychoanalysis, the Ego is the conscious, rational part of the psyche that mediates between the Id’s desires, the Superego’s moral standards, and external reality.

Example: Deciding to study for an exam instead of watching TV, balancing desire with responsibility.

Id

In Freudian psychoanalysis, the Id is the unconscious part of the psyche that contains primal instincts, desires, and drives, operating on the pleasure principle to seek immediate gratification.

Example: Feeling an impulsive urge to eat a snack despite being full, driven by instinct rather than reason.

Indian Knowledge Systems (IKS)

A collective term for philosophical, scientific, and spiritual traditions from India, including *Vedānta*, *Sāṅkhya*, *Yoga*, and *Āyurveda*. These systems emphasize introspection, holistic understanding, and the interconnectedness of mind, body, and cosmos.

Example: Using Yoga's breathing exercises (prāṇāyāma) to calm the mind, based on the belief that breath links physical and mental states.

Jāgrit, Svapna, Suṣupti

Vedānta states of consciousness: *Jāgrit* (waking, engaging with the external world), *Svapna* (dreaming, processing subconscious impressions), and *Suṣupti* (deep sleep, where ego-driven awareness dissolves). These states reflect different modes of mental activity.

Example: Planning a project (Jāgrit), dreaming of flying (Svapna), or sub conscious processes happening without one's will (Suṣupti).

Kāraṇa Śarīra (Causal Body)

The deepest layer in *Vedānta*, representing the root of existence and storing latent tendencies (*samskāra*) or karmic imprints. It is the cause of the *Sthūla Śarīra* (gross body) and *Sūkṣma Śarīra* (subtle body) and is transcended through spiritual liberation.

Example: Unconscious habits or fears that influence behavior, rooted in past experiences or conditioning.

Metacognitive Refinement

The process of improving one's ability to understand, monitor, and regulate their own thinking processes. It involves becoming more aware of how thoughts arise and influence behavior, often through practices like mindfulness or self-reflection.

Example: Recognizing a recurring anxious thought during meditation and consciously choosing to focus on self instead.

Non-Falsifiable Principles

Concepts or laws that cannot be proven false through experiments, yet serve as foundational assumptions in science or philosophy. In the paper, these are compared to universal principles in IKS, like causality.

Example: The law of conservation of energy, which is assumed true but not directly testable in every scenario.

Observer Mode

A metacognitive state where an individual observes their own thoughts, emotions, or behaviors as if from an outside perspective, without being fully immersed in them. Derived

from concepts like *Turiya* (*Vedānta*), *Bodhisattva*-hood (Buddhism), and *Purusha* (*Sāṅkhya*), it enables objective self-analysis.

Example: Noticing anger arising during an argument but choosing to pause and reflect rather than react impulsively.

***Pratītyasamutpāda* (Dependent Origination)**

A Buddhist concept stating that all phenomena arise due to interdependent causes and conditions. It suggests that suffering (*dukkha*) results from specific factors, akin to statistical correlations in science.

Example: Stress arising from overworking, which depends on choices, environment, and habits.

Purusha

In *Sāṅkhya* philosophy, the pure consciousness or true self, distinct from nature (*Prakriti*) and its qualities (*Guṇa*). It is the unchanging witness of all experiences.

Example: The part of you that silently observes thoughts, unchanged by joy or sorrow.

***Sattva, Rajas, Tamas* (Three *Guṇa*)**

Qualities in *Sāṅkhya* philosophy that govern nature and human behavior: *Sattva* (clarity, balance), *Rajas* (activity, desire), and *Tamas* (inertia, ignorance). They interact to shape thoughts, actions, and personality.

Example: Feeling calm and focused (Sattva), driven to achieve a goal (Rajas), or procrastinating (Tamas).

Spirituo-Scientific Domain

A proposed interdisciplinary field that integrates rigorous scientific methods (e.g., empirical research, hypothesis testing) with introspective practices from spiritual traditions (e.g., meditation, self-inquiry). It aims to study consciousness holistically by combining objective data with subjective experiences.

Example: Using neuroimaging to study brain activity during meditation, while also analyzing participants' self-reported insights.

***Sthūla Śarīra* (Gross Body)**

The physical body in *Vedānta* philosophy, composed of the five elements (earth, water, fire, air, ether). It is the temporary, material vessel for sensory experiences and is subject to birth, growth, decay, and death.

Example: The body one sees in the mirror, which feels hunger or pain, but is distinct from thoughts or deeper identity.

Sūkṣma Śarīra (Subtle Body)

The non-physical layer in *Vedānta*, encompassing the mind, intellect, senses, and vital energies (*prāṇa*). It processes thoughts, emotions, and subtle experiences, bridging the physical body and deeper consciousness.

Example: The mind that dreams or feels emotions, which persists even when the physical body is asleep.

Superego

In Freudian psychoanalysis, the Superego is the moral conscience, internalizing societal norms and ethical values to guide behavior.

Example: Feeling guilty for lying because it violates personal or societal standards of honesty.

Transcendence

The act of moving beyond ordinary mental or physical limitations to achieve a higher state of awareness or understanding. In the *Tri-Pada* framework, it refers to rising above ego-driven thoughts or conditioned behaviors to access a detached, universal perspective (e.g., Observer Mode).

Example: Feeling a sense of unity with others during deep meditation, beyond personal identity.

Trikāya Doctrine

A Buddhist framework describing three aspects of a Buddha's being: *Dharmakāya* (truth body, ultimate reality), *Sambhogakāya* (enjoyment body, spiritual fulfillment), and *Nirmāṇakāya* (manifestation body, physical presence). It illustrates levels of consciousness and enlightenment.

Example: A teacher (Nirmāṇakāya) shares wisdom (Dharmakāya) through compassionate actions (Sambhogakāya).

Tri-Pada Principle

A conceptual framework that synthesizes triadic (three-part) models from various traditions to understand consciousness, behavior, and cognition. It integrates constructs like Freud's Id/Ego/Superego, *Vedānta*'s three bodies (*Sthūla Śarīra*, *Sūkṣma Śarīra*, *Kāraṇa Śarīra*), Buddhist *Trikāya* doctrine (*Dharmakāya*, *Sambhogakāya*, *Nirmāṇakāya*), *Vedānta* states of consciousness (*Jāgrit*, *Svapna*, *Suṣupti*), and *Sāṅkhya*'s three *Guṇa* (*Sattva*, *Rajas*, *Tamas*).

Example: Viewing a person's behavior as influenced by primal instincts, sub conscious behaviours, and moral ideals.

Turiya

The fourth state of consciousness in *Vedānta*, beyond waking, dreaming, and deep sleep. It is a state of pure, non-dual awareness, where the self realizes its true nature (*Ātman*) beyond mental constructs.

Example: A moment of profound clarity during meditation, feeling connected to all existence without personal thoughts.

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A Case Study on Murugan Mandala Vaatika – The use of Sacred Geometry in Ancient Gardens

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Abstract:

«The Mandala Vaatika is the art of garden design derived from ancient Vedic scriptures that, in a unique manner combines the science of sound vibrations (Naad), geometric patterns (Cymatics), plants & their unique frequencies - and becomes a medium for one to experience different dimensions of consciousness when these elements join together. It not only resonates with the theory of modern Quantum Physics (how wave functions & their vibrations combine to create the physical world around us) but it also finds similarities with the ancient cultures from Asia, South America, Middle eastern Arabesque, Christianity and Judaism. This knowledge, being so universal and profound, and yet so simple, caters to the intellectual mind of scientists, of those curious individuals wanting to explore different dimensions of life - garden enthusiasts, homemakers and students perfectly well. The paper explores the science of Mandala Vaatika and its relevance to the modern day.»

Keywords: Mandala Vaatika, Sacred Geometry, Vedic Landscapes

INTRODUCTION

When I think of landscapes, the first thing that comes to my mind is the lay of the land and the kinds of greens that come into play. The structure, the materials, and the design principles alongside the greenery, all come together to define the aesthetics of an outdoor space. Whether it's a Japanese garden, a Zen arrangement, an English-style setting, or even a free-flowing, forest-like design, most people can picture these styles easily.

But what's harder to imagine is a garden designed entirely on **Vedic Principles**.

For many, Vedic wisdom isn't immediately associated with landscapes or gardening. But as someone deeply rooted in both agricultural science and landscape architecture, I've delved into

the Vedic past to unearth a different understanding. Ancient Vedic gardens, those that existed thousands of years ago, followed a set of principles where structure and rhythm weren't just aesthetic but channeled energy. The choice and placement of plants weren't random, they followed a clear code aligned with Vedic wisdom, intended to amplify the physical and resonant vibrations of the space.

In my journey, I've explored these deeper meanings, especially those found in the **Gardens of Ancient Gurukuls**. What I've found is that **Sacred Geometry** was the foundational structure of these gardens. At the heart of this geometry is the **Mandala**, intersecting triangles nestled within a circle. This Mandala symbolizes primordial energy, and the surrounding circle acts as a container that holds and stabilizes this energy.

This form isn't unique to India. You'll find the six-pointed star, this sacred structure, in Buddhist, Christian, Chinese, and even Western mystical traditions like Freemasonry. But in Vedic gardens, these symbols referred to as the **mandalas**, were not just decorative. They served as the energy portals and structural foundation of the space.

ELEMENTS OF MANDALA VAATIKA

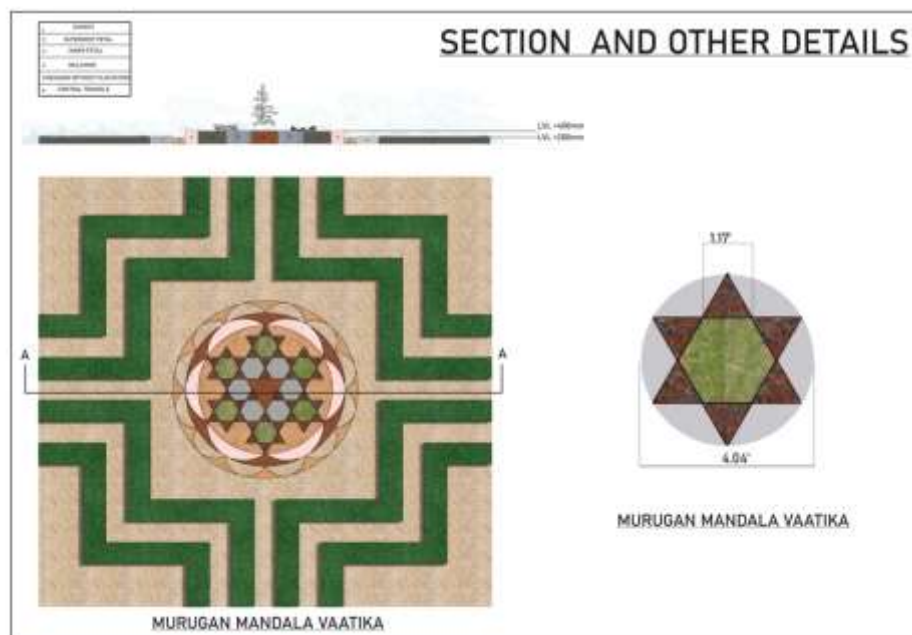
Each mandala can contain different numbers and types of Chakras, and with that, different energetic signatures. For example, a **Ganesha mandala** might contain the six-pointed star, whereas a **Subramanya mandala** might include six hexagons. The variation isn't random, it reflects different frequencies and vibrational energies derived from the **Universal Sound** or **Nada**. This concept is closely tied to **Cymatics**, the study of how sound and vibration influence geometry of form.

In these **Mandala Vaatikas**, three core elements come together:

1. The physical mandala, derived from **Sacred Geometry**
2. The **Beej Mantra**, the sound or vibration linked to the geometry
3. **Specific plants** that resonate with the mandala's frequency

These plants are not selected at whim, they are chosen for their ability to **carry and transmit energy**, much like a radio tuned to a specific frequency. Each plant is a **Vahana**, a carrier of energy, that connects the visitor to the mandala's frequency

Let me share an example that's particularly close to my heart: the **Murugan Vaatika** inspired by **Siddha Bhogar**, a master who lived over 2000 years ago. Siddha Bhogar envisioned the **Murugan Mandala**, as composed of six stars and hexagons enclosed in a circle. He also specified which plants must be placed in this mandala, each with a specific position based on cardinal directions and the location of the six forms of Murugan or Shanmukha.



AN INSTALLATION OF MURUGAN MANDALA VAATIKA

Inspired by this ancient wisdom, I recreated the **Murugan Vaatika** at the **International Art of Living Centre** in Bengaluru, after **Sri Sri Ravi Shankar** drew my attention to this powerful tradition. This mandala includes six specific plants:

- *Origanum majorana*
- *Jasminum articulatum*
- *Michelia champaca*
- *Aegle marmelos*
- *Nerium oleander*
- *Artemisia princeps*

Each of these was carefully placed according to the traditional layout to maintain the resonant frequency and harmony of the original Vaatika.



Gurudev Sri Sri Ravishankar consecrating the Murugan Mandala Vaatika

CLOSING REMARKS

Interestingly, sacred geometry isn't confined to explicitly Vedic spaces. Take **Lutyens' Delhi**, for example. Its layout incorporates triangles and hexagons reminiscent of the **Freemason tradition**, which in turn parallels Vedic geometry. The **Star of David**, widely used in Masonic symbolism, is functionally like the Ganesha Mandala. Even the **Incas, Arabs, Shinto, Taoists**, and **Buddhists** embedded sacred geometry in their traditions. In India, we refer to this six-pointed star as the **Shatkona** or **Ganesha Mandala**.

But perhaps the most powerful and complex example is the **Sri Chakra**, the ultimate mandala in Vedic philosophy. It holds **108 energy portals**, each encircled with petals representing specific types of energy. Plants aligned with each portal's frequency are planted in specific locations in the **Sri Chakra Vaatika**, making them the **Vahanas** of that Tattva's frequency.

To me, designing landscapes is not just about beauty, it's about **resonance, energy**, and connecting with a timeless wisdom that our ancestors knew and practiced.

The Vedic Garden is more than a green space, it's a living, breathing Mandala of Life Force itself.

Brief Profile of the Author:

“Dr. Prabhakar Rao (Chairman, Sri Sri Institute of Agricultural Sciences & Technology Trust) is popularly known as *The seed man of India*.”

“A visionary landscape architect and sustainability champion, Dr. Rao has brought to life some of the world's most iconic projects. From the luxurious Palm Island Village in Dubai and the serene Qurm Park in Oman to the scenic Volga Waterfront in Kazan and the vibrant Amochu Waterfront Township in Bhutan, his work spans continents and captures imaginations.”

“In India, his genius has shaped legendary landmarks like the majestic Sardar Patel Statue in Gujarat, the grand Central Vista Redevelopment in New Delhi, and the transformative Kashi Vishwanath Corridor in Varanasi.”

“But Dr. Rao's journey goes beyond landscapes. During his doctoral studies in agriculture, he realized the pressing need to move away from chemical farming. This sparked his passion for promoting sustainable alternatives, leading him to champion Sri Sri Natural Farming as a trustee of the Sri Sri Institute of Agriculture and Technology since 2013-14.”

“His tenure as COO of the International Association for Human Values in Dubai (1997–2001) saw him spearhead projects on environmental restoration, disaster management, and sustainable ecosystems.”

“A dedicated faculty member of the Art of Living for over 27 years, Dr. Rao blends ancient Vedic wisdom with modern solutions. His promotion of traditional techniques, like the mesmerizing Mandala Vaatika, is inspiring people worldwide.”

Statements and Declaration: Some sections of this paper are also available on my website - mandalavaatika.com. The common sections, which constitutes about 10% of this paper, are included within the quotation marks « and ».

I declare that I have no conflict of interest with my places of employment or anybody else in publishing this article. No financial support was received for the work within this article.



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Systematic Analysis of the Practices of *Prāṇāyāma* for Its Effective Adaption and Adoption

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Abstract:

This paper delves into the breathing practices (*prāṇāyāma*) that are used to control the pranic energy of the body which, in turn, controls the physical and psychological activities resulting in improvement in health and overall well-being. In the last century, many of the breathing techniques mentioned in ancient Indic texts have been adopted, adapted, renamed and promoted. These adaptations and alterations of *prāṇāyāma* can, at times, degrade the effectiveness for the practitioner. This study is an attempt to understand and appreciate the fundamental principles of *prāṇāyāma* and to present a comprehensive framework and roadmap which can be used as a guide by readers to take informed decisions while selecting and practising a particular technique for *prāṇāyāma*.

Keywords: *prāṇāyāma*, *pūraka*, *kumbhaka*, *rechaka*, *bandha*

INTRODUCTION

There are various techniques and exercises that are used to control the pranic energy of the body. The pranic energy is the vital life force or subtle energy that flows within and around us and is responsible for all physical and psychological activities. Thus, by controlling *prāṇa*, one can successfully control the physical and psychological activities resulting in improvement in health and overall well-being.

One may argue that each practice/approach that helps to regulate the flow of *prāṇa*/subtle energy should be termed as *prāṇāyāma*. For example, noble silence (*mouna*), attitude of nonreactivity, peacefulness, pleasure, avoiding conflicts, adopting any stable posture, modifying the breathing, mantra chanting, meditation etc. help in improving the health and overall well-being. But not all of them qualify to be called *prāṇāyāma*. In Yoga, the term *prāṇāyāma* is specifically used for breathing practices that help in regulating the flow of *prāṇa*.

Prāṇāyāma is a broad term and refers to a variety of breathing techniques and exercises. These techniques find a mention in texts which are believed to be at least five thousand years old like *Vedas*, *Smritis*, *Darshanas*, *Puranas*, *Tantras* and *Hathayogic* texts. *Haṭhapradīpikā*, one of the standard books of Hathayoga, mentions that by the practice of *prāṇāyāma*, one can clean the *nāḍīs* (pranic pathways inside the body) and ensure removal of obstacles in the flow of energy and eventually succeed in cleaning the *Sushumna Nāḍī* (central pranic pathway in the body). Once the pranic energy starts flowing freely through *Sushumna*, the practitioner can even reach a state of super consciousness and gain the capability for higher experiences.

In the last century, many of these breathing techniques have been adopted, adapted, renamed and promoted. These adaptations and alterations of *prāṇāyāma* can, at times, degrade the effectiveness for the practitioner. This reduction in effectiveness is essentially due to lack of understanding of the underlying Indic philosophical concepts related to the nature of human existence and its interrelation with the universe.

In this paper I have presented an overview of some of the popular traditional practices of *prāṇāyāma*, analysed them systematically, and then proposed a generic framework and roadmap for adapting and adopting these techniques so that the practitioner can reap the maximum benefits.

SCOPE & METHODOLOGY

While discussing the various techniques and practises of *prāṇāyāma*, I have purposefully avoided discussed the benefits derived from practising *prāṇāyāma*. I am not going into the instructional details of how to practise any technique. This study does not include any comparative analysis. I am assuming that the readers are familiar with the basic Indic philosophical and ontological concepts and the concept of *panchkosh* and therefore, I am not including the same in this study.

The scope of this study is limited to understanding and appreciating the fundamental principles of *prāṇāyāma* so that I can present a comprehensive framework and roadmap which can be used as a guide by readers to take informed decisions while selecting and practising a particular technique for *prāṇāyāma*.

For this research work I have studied various ancient Indic texts and systematically analysed the information related to *prāṇāyāma* contained in them with the objective of understanding the basic principles.

I have consciously adopted the above methodology to ensure that I remain focussed in my attempt to systematically analyse the practices of *prāṇāyāma* for creating a roadmap for its effective adaption and adoption.

REFERENCES OF *PRĀṆĀYĀMA* TECHNIQUES IN ANCIENT INDIC TEXTS

1. In Hathayogic texts for the beginners

Texts like *Haṭhapradīpikā* and *Gheranda Samhitā* contain a variety of inhalation and exhalation techniques which can be used for *prāṇāyāma*. They include techniques and practises like *Ujjayi*, *Bhramari*, *Bhastrika* etc., each prescribing a particular art of inhalation and exhalation. Thus, the practitioners get the freedom of choosing the breathing technique as per their comfort. Hathayogic texts also mention the specific therapeutic benefits that can be obtained from each variety of *prāṇāyāma*.

“*Mandam mandam pibetvayum mandam mandam viyojayeta
Nadhikam stambhayetdvayum na cha shighram vimochaeta*” - *Gheranda Samhitā*

This reference is helpful for the beginners of the *prāṇāyāma*. *Gheranda Samhitā* explains that one should learn the art of slow inhalation and slow exhalation and also instructs the beginners not to hold the breath too long i.e. beyond their capacity.

In *Haṭhapradīpikā* the same instruction is explained as ‘*Yathashakti cha dharayet*’. It means - hold the breath as per your comfort. If one feels uneasiness, suffocation or fear then one should prefer to exhale the air. (Or if one is holding the breath after exhalation then one should prefer to inhale.)

“*Yuktam yuktam tyajet vayu yuktam yuktam cha purayet
Yuktam yuktam cha badhniyat evam siddhimvapnuyat*” - *Haṭhapradīpikā* - 2/18

Inhale skilfully, hold skillfully and exhale skillfully.

2. In Hathayogic texts for the advance practitioners

Gheranda Samhitā explains the discipline that needs to be followed in the practice of *pūraka*, *kumbhaka* and *rechaka* (the art of inhalation, holding the breath and exhalation) for advancement in *prāṇāyāma*. It recommends a particular rhythm of *pūraka*, *kumbhaka* and *rechaka* while doing *prāṇāyāma*. The ideal ratio to be achieved is 1:4:2. For example, if one inhale for 8 seconds then one should hold the breath up to 32 seconds and exhale slowly up to 16 seconds. *Yājñavalkya Samhitā* also mentions the same ratio. In case of *Anulom Vilom* type of *prāṇāyāma* the recommended ratio for beginners is 1:1:2 and for advanced practitioners it is 1:4:2. However, *Haṭhapradīpikā* does not mentioned anything about the ratio that should be followed.

Practicing *prāṇāyāma* with the discipline of ratio can be considered as the advanced practice of *prāṇāyāma*. Advancement in the practice of *prāṇāyāma* is also determined by the number

of *kumbhaka* ((breath holding) that the practitioner follows in a single sitting of *prāṇāyāma*. *Haṭhapradīpikā* mentions 80 breath/*kumbhaka* to be completed in one sitting and *Gheranda Samhitā* specifies 100 breath/*kumbhaka* to be completed in one sitting of *prāṇāyāma* practice.

Further, the advancement in the practice of *prāṇāyāma* is described in three progressive levels which are as follows.

Level 1 - *Kaniyasi prāṇāyāma*: One gets sweating while performing *kumbhaka*.

Level 2 - *Madhyam prāṇāyāma*: One experiences tremors while performing *kumbhaka*.

Level 3 - *Uttam prāṇāyāma*: One experiences total lightness and feels the body like a weightless cotton which is moving easily in the air.

3. In *Apastambh Dharmasutra* –

“*Aa tamitoho pranayamacchedityeke*”

In this technique one inhales and holds the breath till one starts sweating and gets giddiness. This is an advanced technique of *prāṇāyāma*. The significance of this technique is that it indicates the fitness of respiratory organs and associated muscles to hold the breath for a longer time. It also denotes the positive attitude of the mind. This state appears after the prolonged regular practice of *prāṇāyāma*. One can follow this advance *prāṇāyāma* only when one is physically and mentally fit.

In *Haṭhapradīpikā* it is said that if one follows some easy practices of *prāṇāyāma* regularly, then one is able to hold the breath for a longer time as per one's will. Calmness and stabilization of metabolic rate are the conditions which makes the person capable for longer practice of *kumbhaka* (breath holding).

This practice is too risky for beginners because beginners may panic when they feel suffocation during the practice of *kumbhaka*. They can show signs of activation of sympathetic system resulting in stress reaction e.g. increased heart rate, rapid breathing, sweating, fear etc. This is also not recommended for people of “panic-phobic personality”.

4. In *Pātanjala Yoga Sūtra* –

“*Tasmin sati shwas prashwasyoho gativicchedaha pranayama*” 2/49

“*Bahyabhyantar stambhavrutti deshkalasamkhyabhihi paridrushto dirghasukshmaha*” 2/50

“*Bahyabhyantar vishayakshepi chaturthaha*” 2/51

The above *sūtra* (i.e. verse) explains the practice of *prāṇāyāma* as holding the breath (*Gativiccheda*). In this technique one stops the movement of breathing for some time. If one stops it after inhalation, it was called *abhyantar stambhavrutti*. If one stops the movement after exhalation, it was called *bahya stambhavrutti*. If one stops the breath both times i.e. after

inhalation and exhalation also, it was called *bahyabhyantar stambhavrutti*. All the three variations of this technique are followed purposefully i.e. as per our will. Thus, it is the part of voluntary breath regulation.

A further *sūtra* explains the fourth variant of *kumbhaka* which occurs after the regular and prolonged practice of *prāṇāyāma*. In Hathayogic texts, this has been described as *keval kumbhaka* in which the breath is not purposefully stopped but get stopped automatically. In this condition the person do not feel the urge to inhale or exhale or hold. He just experiences that the breath is stopped automatically for some time. This is a temporary phenomenon. When the *yogi* attains this state, he experiences a state of stillness. The usual flow of thoughts becomes significantly weak and one enjoys the state of *Samatva* i.e. *Samadhi*. The activation of *Kundalini* i.e. attaining the state of super consciousness is possible in the state of *keval kumbhaka*.

5. In *Vijnana Bhairav Tantra*

“*Kumbhita rechita vapi purita va yada bhavet
Tadante shantanamasou shktya shantaha prakashate*” Verse -27

In the technique described in *Vijnana Bhairav Tantra* the emphasis is on the art of inhalation, exhalation and holding the breath i.e. *Pūraka*, *rechaka* and *kumbhaka* respectively. *Pūraka* means filling the lungs skillfully by air and *rechaka* means to draw out the air skillfully from the lungs. Thus, along with the art of holding the breath, the skillful inhalation and exhalation are also important parts of *prāṇāyāma*.

6. In *Adi Shankaracharya's Yogataravali*

“*Bandha-traya-abhyasa-vipaka-jatam vivarjitam rechaka-Pūrakabhyam.
Vishoshayantim vishaya-pravaham vidyam bhaje kevala-kumbha-rupam*” Verse-8

In this reference, the practice of *bandha* (i.e. to lock) is explained along with the other parts of *prāṇāyāma* i.e. *Pūraka*, *kumbhaka* and *rechaka*. The practice of *bandha* helps to lock/hold the state of *kumbhaka*. This is done with the help of contraction of muscles of the trunk. The contraction of perineal and pelvic muscles is called *mulabandha*. The contraction of abdominal and mid back muscles, particularly the diaphragm, is known as *uddiyana bandha*. The contraction of neck and upper trunk muscles (upper back and chest muscles) is *jalandhara bandha*. Shankaracharya explained the spiritual importance of *tribandha prāṇāyāma* (simultaneous application of the above three locks) for the development of super consciousness wherein the practitioner experiences a state of stillness and detachment from the world.

DISCUSSION: USEFULNESS OF ANCIENT TECHNIQUES AND NEED TO DESIGN IMPROVISED TECHNIQUES

All references about the *prāṇāyāma* techniques in the ancient Indic texts are in the form of *sūtra* or *shloka* (short verse). There are no detailed instructions for practicing *prāṇāyāma* and a lot has been left for interpretation. As a result, the beginners have to take help from experienced practitioners. They have no means to verify the recommendations received from these experienced practitioners. Many modern schools of yoga have created their own methods aligning with the frameworks given in the ancient text and claim that their recommendations are the best suited. The point to be noted here is that there are not many structured and evidence based scientific studies of these adaptations. Hence, there is no way to ascertain the benefits that can be derived from each variant of *prāṇāyāma* or to grade them based on their comparative usefulness.

There is a high likelihood that the thousands of yogis who practiced *prāṇāyāma* in the older days used to follow multiple variants of breathing practices. And there is an equally high likelihood that not all those practices found mention in the Hathayogic texts compiled by various rishis. Only the very popular ones survived. Hence, there is always a probability of discovering a better and a more effective technique or rediscover a variant that was followed in ancient times. This implies that we should not discourage the current trend of adopting and adapting the age-old methodologies existing in the ancient texts. We should remain open to the idea that the new and contemporary variants created after understanding the clues given in traditional texts may create something more efficient and useful.

FRAMEWORK FOR DESIGNING IMPROVISED TECHNIQUES OF *PRĀṆĀYĀMA*

Taking cognition of the guidelines given in *Haṭhapradīpikā* and other ancient texts, I am listing below some important points that need to be kept in mind while adopting and adapting any technique of *prāṇāyāma*.

- The practitioner should be advised to proceed as per his/her comfort level. There should be no fixed timelines or goals.
- The practitioner should be encouraged to move to more advance levels gradually, yet consistently. One can set the target of advancement as per the number of breaths in one sitting. For example, initially he/she may complete 20 breath. Then try for 30, slowing increase to 40 and so on. After some days he/she will be able to complete at least 80 breath.
- In the beginning there should not be compulsion to follow a predefined ratio of time for inhalation, holding and exhalation of breath. After regular practice he/she will become skilled to inhale slowly, hold for longer duration and exhale very slowly. Before encouraging the practitioner to follow the recommended ratios, he/she should

be given enough time to achieve the proper fitness of respiratory organs and associated muscles.

- Initially the practitioner should not be advised to include *bandha* in his/her *prāṇāyāma* routine. Later on, as he/she progresses in *kumbhaka*, he/she should be initiated to include *bandha* and proceed to the next level of advancement in *prāṇāyāma*. Many regular practitioners advise that *kumbhaka* up to 20 seconds does not require *bandha*. But when one needs to hold breath for longer time, one should take the help of *bandha* because it makes the state of *kumbhaka* easy. Contracted muscles of the trunk help to keep the contracted state of respiratory muscles which increases stability in *kumbhaka*.
- Another sound advice that should be kept in mind is that after the practice of long *kumbhaka* one needs to relax the respiratory muscles. Thus, after one round of pranayamic breath the practitioners can take a little rest in which they can follow usual breathing, maybe 3 to 5 times or as per their convenience. Then one can follow further pranayamic breath. In other words, there should be a little period of rest between two *kumbhaka*. This practical fact is not described in any Hathayogic text but explained by yogis who have been doing *prāṇāyāma* for years.

RECOMMENDED “PROGRESSION PLAN” FOR GETTING INITIATED INTO ANY TECHNIQUE OF *PRĀṆĀYĀMA*

In the beginning, the lungs, respiratory muscles and associated trunk muscles are not trained for the practice of *prāṇāyāma*. Therefore, it is required that the practitioner is initiated into *prāṇāyāma* using a structured & graduated plan which ensures skillful learning and also enables the practitioner to become fit for further advanced practices of *prāṇāyāma*.

Based on my extensive study of *prāṇāyāma*, which I have presented in this paper, I have designed a “Progression Plan” that can be followed.

***Pūraka - Rechaka* pattern (PR pattern)**

The lungs of the beginners cannot tolerate the state of stretching of elastic tissue that happens during *kumbhaka*. For such beginners, the PR pattern is very useful wherein the practitioner is only working of inhalation and exhalation and completely avoids holding of breath. The practitioner should start with a small time period for inhalation & exhalation (say 6 seconds each) for as many repetition cycles as he/she is comfortable with. Over the next few days, the attempt should be to increase the number of repetition cycles without changing the duration of inhalation and exhalation. Once the practitioner is able to comfortably complete 80 to 100 repetition cycles of 6 seconds in one sitting, his/her next attempt should be to increase the duration of inhalation and exhalation to, say, 8 seconds each; again, for a small number of repetition cycles, say, 20.

The practitioner should slowly and gradually work on increasing the period of inhalation & exhalation (***Pūraka – Rechaka***) and the number of repetition cycles as suggested in the table

below. After enough practice, the elasticity of lung tissues is improved and the respiratory muscles learn to relax slowly in a rhythmic fashion.

<i>Pūraka</i>	<i>Rechaka</i>	Repetitions
6 sec	6 sec	20-30-40....80
8 sec	8 sec	20-30-40....80
10 sec	10 sec	20-30-40....80
12 sec	12 sec	20-30-40....80

Pūraka – Kumbhaka - Rechaka pattern (PKR pattern)

In this pattern, one can inhale slowly as per capacity, hold the breath as per capacity and then exhale as per capacity. In this way, one should follow 20-30-40 repetition and gradually move up to 80. Thereafter, the practitioner should increase the duration of inhalation, hold and exhalation (*Pūraka – Kumbhaka – Rechaka*) as suggested in the table below. The practitioner should initially start with 1:1:1 ratio and gradually move on to 1:4:2 ratio. A suggested progression plan can be 1:1:1 -> 1:1:2 -> 1:2:2 -> 1:3:2 -> 1:4:2. The practitioner should also use *bandha* when the *kumbhaka* duration increases. The use of *bandha* is mandated if the duration of *kumbhaka* is beyond 20 seconds. Before that the use of *bandha* is optional.

<i>Pūraka</i>	<i>Kumbhaka</i>	<i>Rechaka</i>	Repetitions
8 sec	8 sec	8 sec	20-30-40....80
10 sec	10 sec	10 sec	20-30-40....80
12 sec	12 sec	12 sec	20-30-40....80
8 sec	8 sec	16 sec	20-30-40....80
10 sec	10 sec	20 sec	20-30-40....80
12 sec	12 sec	24 sec	20-30-40....80
8 sec	16 sec	16 sec	20-30-40....80
10 sec	20 sec	20 sec	20-30-40....80
12 sec	24 sec	24 sec	20-30-40....80
8 sec	24 sec	16 sec	20-30-40....80
10 sec	30 sec	20 sec	20-30-40....80
12 sec	36 sec	24 sec	20-30-40....80
8 sec	32 sec	16 sec	20-30-40....80
10 sec	40 sec	20 sec	20-30-40....80
12 sec	48 sec	24 sec	20-30-40....80

Pūraka – Rechaka - Kumbhaka pattern (PRK pattern)

In this pattern the practitioner inhales slowly as per capacity then exhales slowly as per capacity and then holds the breath as per capacity. The practitioner should initially start with 1:1:1 ratio and gradually move on to 1:4:2 ratio. A suggested progression plan can be 1:1:1 -> 1:2:1 -> 1:2:2 -> 1:2:3 -> 1:2:4. The practitioner should also use *bandha* when the *kumbhaka* duration increases. The use of *bandha* is mandated if the duration of *kumbhaka* is beyond 20 seconds. Before that the use of *bandha* is optional.

<i>Pūraka</i>	<i>Rechaka</i>	<i>Kumbhaka</i>	Repetitions
8 sec	8 sec	8 sec	20-30-40....80
10 sec	10 sec	10 sec	20-30-40....80
12 sec	12 sec	12 sec	20-30-40....80
8 sec	16 sec	8 sec	20-30-40....80
10 sec	20 sec	10 sec	20-30-40....80
12 sec	24 sec	12 sec	20-30-40....80
8 sec	16 sec	16 sec	20-30-40....80
10 sec	20 sec	20 sec	20-30-40....80
12 sec	24 sec	24 sec	20-30-40....80
8 sec	16 sec	24 sec	20-30-40....80
10 sec	20 sec	30 sec	20-30-40....80
12 sec	24 sec	36 sec	20-30-40....80
8 sec	16 sec	32 sec	20-30-40....80
10 sec	20 sec	40 sec	20-30-40....80
12 sec	24 sec	48 sec	20-30-40....80

Pūraka – Kumbhaka – Rechaka - Kumbhaka pattern (PKRK pattern)

This is for more advanced practitioners and can follow as per his/her capacity.

FUTURE DIRECTION

Many modern schools of yoga have created their own methods of *prāṇāyāma* aligning with the frameworks given in the ancient text and claim that their techniques are the best suited and yield maximum benefits to the practitioners. The point to be noted here is that there are not many structured and evidence based scientific studies of these adaptations. Hence, there is no way to ascertain the benefits that can be derived from each variant of *prāṇāyāma* or to grade them based on their comparative usefulness.

We therefore suggest further research in terms of a quantitative study of effectiveness of *prāṇāyāma*. These studies can measure changes in physical parameters like blood pressure, blood parameters like sugar levels, KFT, LFT etc, and also measuring mental well-being using specially designed questionnaires before and after the participants have started practicing *prāṇāyāma* and compare these values with those of a control group.

CONCLUSION

Prāṇāyāma is a progressive practice which starts with modifications in breath voluntarily and finally the practitioner reaches the automatic state wherein he/she experiences effortless stoppage of breath for some time. This is the final destination of the practice of *prāṇāyāma* which known as *keval kumbhaka* and in this condition the practitioner can even reach a state of super consciousness and gain the capability for higher experiences.

By practising *prāṇāyāma* technique which adhere to the framework outlined in the section “Framework For Designing Improvised Techniques Of *Prāṇāyāma*” the practitioner can improve his/her health and well-being. These benefits can be derived by both beginners as well as advanced practitioners, though the quantum of benefits derived will vary as per the level of competency achieved by the practitioner. The proposed quantitative studies outlined in the “Future Direction” section provides actionable pathways for quantifying the improvements in health and overall well-being that can be expected.

Brief Profile of the Author:

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The Role of Yoga in Managing Adverse Effects of Cancer Therapies

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Abstract:

Cancer treatments such as chemotherapy, radiation, and surgery often result in significant physical, psychological, and social side effects that reduce patients' quality of life (QoL). Complementary therapies, particularly yoga, have emerged as effective strategies to mitigate these adverse effects and enhance overall well-being. This review explores the multifaceted role of yoga in managing the physical, psychological, and social challenges faced by the cancer survivors. Yoga, incorporating asanas (physical postures), pranayama (breathing techniques), and meditation, has demonstrated notable physical benefits, including reduced cancer-related fatigue, improved mobility, and enhanced physical function. Psychological benefits include alleviation of depression, anxiety, and stress through mechanisms such as reduced cortisol levels and pro-inflammatory cytokines. Additionally, yoga significantly improves sleep quality and helps manage cancer-related fatigue, offering restorative support during treatment and recovery. The social well-being of cancer patients is also positively impacted by group yoga sessions, which foster community support and reduce social isolation, a common issue among patients. Beyond symptom relief, yoga influences biological mechanisms such as reduced inflammation and improved immune function, further underscoring its therapeutic potential.

Keywords: Cancer therapies, Yoga, Quality of life (QoL), Cancer-related fatigue

INTRODUCTION

Cancer is major health concern globally, wherein chemotherapy, surgery, and radiation therapy are the first line of treatments. Although these are essential for the management of cancer in the initial stages, they often lead to psychological and physical side effects which impairs their quality of life (Pitman et al., 2018; Pandey et al., 2006; Miranda et al., 2002; Lewandowska et al., 2020; Ho et al., 2018). To address these challenges and improve the overall well-being of patients, complementary approaches, such as yoga, are increasingly being incorporated into cancer care regimens. Yoga practices including asanas, pranayama, and meditation have demonstrated positive health benefits and has proven to be a promising alternative therapy for cancer survivors (Danahauer et al., 2019; Blockhuys et al., 2024). This review examines existing evidence on how yoga contributes to enhancing physical, emotional, and social well-being in cancer patients.

PHYSICAL BENEFITS OF YOGA IN CANCER CARE

Cancer survivors and patients experience adverse physical symptoms such as pain, fatigue, and limited mobility which diminishes their quality of life (QoL) significantly (Dong et al., 2014; Johnsen et al., 2009). Recent studies have suggested that yoga practices can address these physical symptoms effectively. A study by Cramer et al. (2017) reported that yoga practices helped breast cancer survivors to improve their physical functioning and reduce cancer-related fatigue. Similarly, another study by Chandwani et al. (2014) demonstrated that structured yoga protocol improved physical stamina and alleviated cancer-related fatigue caused due to chemotherapy among breast cancer survivors. Further, Buffart et al. (2012) also demonstrated that yoga practices have positive impact on psychosocial and physical symptoms in patients suffering from breast cancer. Thus, it has been well established that yoga is a gentle, flexible, and effective form of therapy which supports physical and psychological recovery in cancer patients without putting excessive strain on them.

PSYCHOLOGICAL BENEFITS OF YOGA

Past research studies have shown that cancer often impacts mental health of patients often causing symptoms of anxiety, depression and post-traumatic stress disorder (PTSD) (Kvillemo & Bränström, 2011; Pirl, 2004; Massie, 2004; Kangas, Henry, & Bryant, 2002). Yoga has shown to be effective in managing these psychological symptoms, helping to foster a positive mental outlook among patients. A study conducted by Culos-Reed et al. (2006) indicated that there was a significant reduction in depression, stress, and anxiety in cancer patients practicing yoga. Similarly, other studies showed that yoga was beneficial in improving mental health of cancer survivors (Lundt, & Jentschke, 2019; Hardoerfer, & Jentschke, 2018).

A systematic review study by Lin et al. (2011) demonstrated that mindfulness-based yoga practices decreased anxiety levels and depressive symptoms along with improving quality of life for different types of cancer patients. Most of the psychological benefits can be attributed to yoga's ability to reduce pro-inflammatory cytokines and cortisol levels, which are elevated due to various cancer therapies and are associated with inflammation and stress (Bower et al., 2011; Bower, & Lamkin, 2013). Thus, this neurobiological mechanism offers scientific basis for understanding yoga's role in improving mental well-being, substantiating its role as holistic adjunct treatment in cancer care.

IMPROVEMENTS IN SLEEP QUALITY AND FATIGUE MANAGEMENT

Chemotherapy, radiation, and surgery often cause sleep disturbances and cancer-related fatigue (CRF) in cancer patients. These side effects lead to increased psychological distress along with physical debilitation among cancer patients (Bower et al., 2014). It is evident from past studies that cancer-related fatigue was lowered by 50% along with notable improvement in both sleep duration and quality after practicing specifically designed yoga program for cancer survivors (Mustian et al., 2013). These results were supported by another review study conducted by Cramer et al., (2017) which affirmed that yoga practices improve sleep quality leading to restorative sleep necessary for cancer patient's recovery. Similarly, another recent study by Hou et al. (2024) reported that yoga practices significantly reduced cancer-related fatigue in breast cancer survivors. This meta-analysis and systematic review also emphasized that yoga practices lowered fatigue levels along with enhancing physical fitness and overall quality of life. Additionally, another meta-analysis conducted by Dong et al. (2019) explored the effect of yoga practices on cancer-related fatigue in breast cancer survivors. This study reviewed 17 research studies involving 2,183 breast cancer survivors. The results of this study showed that yoga practices significantly reduced cancer-related fatigue, mainly in cancer survivors post treatment. It was observed that longer duration sessions had significant effect on fatigue as compared to shorter duration intervention. Thus, yoga can be positioned as an important complementary and alternative therapy for breast cancer survivors dealing with fatigue.

SOCIAL WELL-BEING AND COMMUNITY SUPPORT

Social isolation often causes significant challenge for various cancer patients, leading to adverse effects on their well-being and overall health. Recent research studies revealed that social isolation and loneliness may contribute to several negative health conditions like onset of chronic illness, malnutrition, depression, anxiety, and higher mortality rates (Chaudhary, 2023; Beutel et al., 2022; Wang et al., 2023). These findings suggest that there is a critical need to tackle social isolation and foster social connections among individuals suffering from cancer. In this context, group yoga classes provide a social setting that provides a sense of community and support, which can alleviate feelings of loneliness. Yoga classes designed for cancer patients often include discussions that encourage openness and mutual support, helping to

reduce the stigma and isolation associated with cancer. This social aspect is particularly valuable, as it reinforces social connectedness, which is a critical determinant of QoL.

BIOLOGICAL MECHANISMS AND YOGA'S THERAPEUTIC EFFECTS

Yoga's role in cancer care extends beyond alleviating symptoms, as it engages biological mechanisms that promote healing and build resilience. Research study conducted by Bower et al. (2014), has shown that yoga practices lower the levels of pro-inflammatory cytokines like IL-6 and C-reactive protein. In fact, it has been found that these inflammatory markers are associated with depression and fatigue in cancer survivors. Reduced levels of these biomarkers correlate with enhanced immune function, providing a scientific basis for yoga's positive effects on both physical and emotional well-being.

Furthermore, it is evident from the past studies that yoga practices reduce stress hormone like cortisol and regulate stress responses which are frequently elevated in cancer patients. Yoga practices help in regulating hypothalamic-pituitary-adrenal (HPA) axis and help in reduction of stress in cancer patients (Rao et al., 2018). These findings indicate that yoga may enhance resilience in cancer patients, potentially supporting them throughout their treatment and recovery process.

FUTURE RESEARCH

This review highlights yoga's adaptability and low-impact nature, making it a practical and effective adjunctive therapy in cancer care. As evidence grows, yoga is poised to become a key component of integrative oncology, offering a holistic approach to improving patients' QoL and supporting their healing journey. Future research should focus on developing standardized protocols tailored to cancer types, stages, and treatment regimens.

CONCLUSION

Yoga offers a holistic, evidence-based approach to addressing the physical, psychological, and social challenges faced by cancer patients. Its adaptability, low impact, and integration of body-mind techniques make it a suitable adjunct therapy, potentially enhancing conventional cancer treatments and improving QoL. Future studies should aim to develop standardized yoga protocols according to specific cancer types, stages, and treatment regimens to optimize outcomes. As the research on yoga's role in cancer care grows, it is likely to become an essential component of integrative oncology, offering a comprehensive approach to healing and support.

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A Systematic Review of the Concept of *Ojas* in *Āyurveda* and Its Parallels in Traditional Medical Systems

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Abstract:

In Ayurvedic medicine, *Ojas* is regarded as the essence of life energy, immunity, and vitality. It is the most refined by-product of digestion and metabolism, representing the culmination of the Seven *Dhātus* (tissues). *Ojas* serves as a protective shield, maintaining physical, mental, emotional, and spiritual well-being. This paper explores the concept of *Ojas* in *Āyurveda*, its production, maintenance, and signs of imbalance, while drawing parallels with similar vital substances in other traditional medical systems such as Siddha, Unani, Tibetan, and Han Chinese medicine. The study highlights the universal recognition of a vital essence across traditional medical systems and cultures, emphasising its role in health, longevity, and holistic well-being.

Keywords: *Ojas*, *Āyurveda*, Seven *Dhātus*, Vital Essence, Traditional Medicine, Holistic Health

INTRODUCTION

Ojas (ओजस), a cornerstone of Ayurvedic medicine, is considered the body's essential life energy and immunity reserve. It is understood or believed to be a subtle essence that circulates throughout the body and protects against disease and aging.

Ojas is derived from the Seven *Dhātus* (सप्त धातु) and functions as a protective shield and is integral to vitality, resilience, and overall health, offering protection against disease, stress, tension, and aging. It is closely linked to mental, emotional and spiritual well-being, fostering states of contentment, happiness, and spiritual clarity.

SCOPE

This short paper offers a scholarly exploration of *Ojas* and its transcultural significance. It aims to elucidate the concept of *Ojas* in *Āyurveda* and examine its analogues in other traditional medical systems.

OJAS IN ĀYURVEDA

Ojas is the refined essence of the Seven *Dhātus*, representing the pinnacle of digestion and metabolism. These seven *Dhātus* are

- *Rasa* (रस): Plasma – It helps in transportation of nutrients, hormones, proteins etc.
- *Rakta* (रक्त): Blood – It helps in circulation of oxygen
- *Mamsā* (ममसा): Muscle – It covers all organs and provides stability and power to the body
- *Medā* (मेदा): Fat – It stores reserve energy
- *Asthi* (अस्थि): Bone – It provides basic structure and strength
- *Majjā* (मज्जा): Marrow – It provides nourishment to the nervous system (including brain and spinal cord)
- *Shukra* (शुक्र): Reproductive Tissue – It nourishes the reproductive strengths

All the Seven *Dhātus* are inter-connected and the malfunctioning of a single *Dhātu* can have an impact on all the other *Dhātus*, and, in turn, on *Ojas*. Depletion or imbalance of *Ojas* manifests as

- fatigue
- weakness
- susceptibility to illness
- lack of vitality
- mental-emotional foggy
- lack of spirit

The production and maintenance of *Ojas* relies on

- balanced and healthy diet
- proper digestion
- adequate rest
- harmonious & wholesome lifestyle

Therefore, Ayurvedic treatments focus on restoring *Ojas* through

- dietary interventions
- lifestyle modifications
- natural remedies
- rejuvenation therapies

OJAS AND CONVENTIONAL MEDICINE

Ojas functions as a protective shield, safeguarding the body from illness and promoting longevity. It is closely linked to mental, emotional and spiritual well-being, fostering states of contentment, happiness, and spiritual clarity. In conventional medicine there is no direct equivalent to the concept of *Ojas*. However, parallels can be drawn to

- immune system functions
- energy reserves in the body
- overall vitality regulated by physiological processes.

Conventional medical science groups the organs of the body into various organ systems. Each organ system performs a specific function in the body. The Seven *Dhātus* and their equivalent (though not necessarily the same) organ system are

- *Rasa*: circulatory system
- *Rakta*: respiratory system
- *Mamsā*: muscular system
- *Medā*: digestive system
- *Asthi*: skeletal system
- *Majjā*: nervous system
- *Shukra*: reproductive system

PARALLELS IN TRADITIONAL MEDICINE SYSTEMS

While *Āyurveda* uniquely conceptualises *Ojas*, similar notions of a vital essence exist in other traditional medical systems:

- **Siddha Medicine:** The concept of Oordhvam or Ooragam represents the body's essence, responsible for vitality and immunity.
- **Unani Medicine:** Quwwat-e-Mudabbira (Vis Medicatrix Naturae) embodies the body's inherent healing and self-regulatory mechanisms.
- **Tibetan Buddhist Medicine:** Nyingpo or Jing is the fundamental life force associated with longevity and spiritual development.
- **Tibetan Bon Medicine:** Thigle is the subtle essence of the body and mind, vital for clarity and well-being.
- **Han Chinese Medicine:** Essence (Jing), one of the Three Treasures alongside Qi (Vital Force) and Shen (Mind), is the foundation of growth, development, and vitality.

DISCUSSION

«From an early age, I was trained in ancient druid lore, which promotes the cultivation of honorable connections and relationships with the physical, energetic, and spiritual landscapes—flora, fauna, the kingdom of fungi, lichen, algae, bodies of water, landforms, and diverse human beings of the world—as well as with nature deities and spirits of nature. In my late teens and throughout early and late adulthood, I was trained in Vedic Aryan lore while living in Bharat, or India, for many years. This training emphasised spiritual disciplines such as yoga, mantra repetition, meditation, pranayama, martial arts, sacred sexuality or tantra, and the ceremonial use of entheogens.»

«My unique blend of druidic and Vedic Aryan knowledge along with formal education in clinical medicine, psychology, and psychiatry positioned me as a bridge between ancient wisdom and modern spirituality, exploring intersections such as nature and ecology, spiritual practices, holistic understanding of the self, cosmology, mythology and symbolism, and healing modalities fostered a deeper understanding of spirituality, nature, and the interconnectedness of all life.»

The concept of *Ojas* in *Āyurveda* and its analogues in other traditional medical systems underscore the universal recognition of a vital essence essential for health and well-being. While these systems differ in traditional medical terminology and cultural context, they converge on the importance of nurturing this essence through healthy diet, lifestyle, and spiritual practices offering insights into how individuals can live in harmony with themselves, each other, and the planet, including all animate and inanimate beings.

CONCLUSION

Ojas, as the essence of life energy in *Āyurveda*, plays a pivotal role in maintaining health, vitality, and resilience. Its parallels in Siddha, Unani, Tibetan, and Han Chinese medicine highlight a shared understanding across traditional medical systems and cultures. By integrating traditional medical wisdom with contemporary, conventional science, we can deepen our understanding of holistic health and well-being.

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“Dr. Maclean Pagon completed his medical training at the Tianjin International University of Modern and Traditional Medicine and Pharmacology, with clinical placements at Teaching Hospitals No.1 and No.2, and Tianjin Nankai Hospital of Integrated Medicine, earning an MBBS degree. He pursued a PhD in the History of Medicine at the Faculty of Medical Studies, Open University, Sri Lanka. Further research and clinical studies led to a Doctorate in Medicine (MD) and a Doctorate in Clinical Psychiatry, specialising in Integrated and Transcultural Psychiatry, at Tianjin Medical University, under the guidance of Academician Professor Dr. Wu Xian Zong, a WHO expert. His doctoral thesis was titled: "Somatisation of Mental-Emotional Distress: A Transcultural View."”

“Recently, he returned from a six-month trip to India (Bharat), where he continued integrating Ayurveda, Siddha, Unani, Tibetan Buddhist, and Tibetan shamanic medicines and spiritual practices into his personal and clinical work with patients. Currently, he operates a licensed clinical practice in holistic medicine and psychiatry in Miraflores, Lima, and Tarapoto, San Martín (Province), Peru.”

“He actively conducts field research on medicinal and entheogenic plants, mushrooms, lichens, and other natural medicines across Peru’s diverse regions, collaborating with university researchers in the Peruvian Amazon.”

Statements and Declaration: Some sections of this paper are also available in my profile which is uploaded on the website of the organisation that I am associated with (psaequilibrium.com). I have marked these common sections within quotation marks (« and »).

I also declare no conflict of interest. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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Perspective: Consciousness and the New Age of Benevolence

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INTRODUCTION

What is consciousness? Is it a byproduct of complex neurobiological processes, or is it the ground from which all reality arises? This question, bridging neuroscience, quantum physics, and ancient spiritual philosophies, has captivated thinkers for millennia. In this essay, we explore two major perspectives: one that sees consciousness as an emergent property of the brain, and another that considers consciousness a fundamental, universal principle. To deepen our analysis, we will compare insights from *Advaita Vedanta*, *Mahayana Buddhism*, contemporary neuroscience, and theoretical quantum physics.

CONSCIOUSNESS AS AN EMERGENT PROPERTY

The prevailing scientific view suggests that consciousness arises from the brain's complex neuronal interactions. According to this model, the brain functions like a highly sophisticated information processor. When sufficient neural complexity is achieved, subjective awareness—what philosopher David Chalmers calls the 'hard problem of consciousness'—emerges.

Supporters of this view cite empirical evidence: brain injuries alter personality and cognition, and neuroimaging shows correlations between brain activity and mental states. Artificial intelligence models even demonstrate basic decision-making and perceptual faculties. However, critics argue that this model fails to explain why these physical processes should give rise to subjective experience at all.

CONSCIOUSNESS AS FUNDAMENTAL

An alternative view, found in both ancient spiritual traditions and some modern scientific theories, posits that consciousness is not produced by the brain but rather is the foundational reality itself.

In *Advaita Vedanta*, consciousness (*chit*) is the substratum of existence. The individual self (*Atman*) is not a product of the body-mind complex but is identical with Brahman, the infinite consciousness. The brain and mind merely reflect this awareness, much like a mirror reflects the sun.

Mahayana Buddhism similarly sees the self as an illusion—there is no enduring essence (*anatta*). Yet, it also posits a luminous, non-dual awareness that underlies all experience. Enlightenment involves realizing the emptiness (*shunyata*) of all phenomena while resting in this pure awareness.

In quantum physics, the observer appears to influence the observed. The measurement problem in quantum mechanics—where the act of observation collapses a wavefunction into a particle—has led some physicists to suggest that consciousness plays a fundamental role in shaping reality. The Penrose-Hameroff 'Orch-OR' theory proposes that quantum-level events in the brain's microtubules may be linked to a universal field of proto-consciousness.

These perspectives suggest that the brain acts more like a receiver or filter of consciousness than its generator. Just as a television set receives signals without creating the content, the brain may channel a universal awareness into localized, individual experience.

INTEGRATIVE REFLECTIONS

While neuroscience seeks to decode the mind's mechanisms, spiritual traditions aim to transcend the mind entirely. Interestingly, quantum physics—once strictly materialist—is beginning to converge with mystical perspectives, hinting at a non-local, interconnected fabric of reality.

In *Vedanta* and Buddhism, the goal is not to define consciousness, but to realize it directly. This realization brings liberation: *Moksha* in *Vedanta*, *Nirvana* in Buddhism. In contrast, science seeks to model and predict, yet struggles to even define what experience is.

These diverse traditions may be approaching the same truth from different directions. Science dissects the content of consciousness; spirituality seeks union with its source. Neuroscience builds the map; *Vedanta* and Buddhism ask, 'Who is the one reading the map?'

A NEW AGE OF BENEVOLENCE AMID GLOBAL SHIFTS

As humanity navigates the turbulence of the present era—marked by dedollarization, decolonization, deradicalization, and deglobalization—it becomes increasingly evident that the old paradigms of economic, political, and spiritual dominance are crumbling. The recent slide in the U.S. Dollar Index (DXY), hovering around 100.41 as of April 2025, signals not just a weakening of currency but a shift in global sentiment. While not technically the lowest in three years, it reflects declining confidence in the dollar's role as a reserve currency and echoes a growing global pivot toward new systems of value and trust.

This is not merely economic adjustment—it is spiritual and philosophical transformation. As the illusion of limitless growth fades and global markets enter a phase of recalibration, the vacuum it leaves can either invite chaos or open space for a higher order—a New Age of Benevolence. Benevolence is not policy; it is silent goodwill, the inner power of consciousness manifesting as empathy, sustainability, and collective upliftment.

In this transitional phase, where stock markets may melt down and old alliances fracture, the return to spiritual truths becomes more than a refuge—it becomes a blueprint. A civilization that learns to see through the noise, dissolve the ego, and realize the interconnected field of consciousness will be one capable of shaping a world beyond fear and scarcity. This age demands not more control, but deeper surrender. Not conquest, but realization. Not profit, but presence.

Benevolence, then, is not weakness—it is the creative power of awareness reclaiming its central role in shaping civilization.

CONCLUSION

Consciousness remains one of the greatest frontiers of human inquiry. Whether it is a product of complexity or the bedrock of being, the pursuit of its understanding unites disciplines across time and culture. As quantum physics deepens our view of the observer's role and spiritual philosophies remind us of the observer's essence, a new paradigm may emerge—one in which consciousness is not merely explained, but directly known. In this synthesis, the mind may finally come to rest in that which it has always sought: itself.

Brief Profile of the Author:

“Prof. Nixon Patel is a visionary leader, an exemplary technocrat and a business oriented successful serial entrepreneur. He has Bachelor of Technology (hons) in Chemical Engineering from IIT Kharagpur, an MS in Computer Science from New Jersey Institute of Technology, Data Science Specialization from Johns Hopkins University, Certificate in Quantum Computing and Information from Massachusetts Institute of Technology & a second Masters in Business and Science in Analytics from Rutgers University. Currently he holds the positions of Founder for Qulabz/Qulabs, Inter-ministerial Committee member of Quantum Communications Dept of Telecom, Member of Cyber Security Advisory Committee in IFSCA GIFT City, Government of India, Adjunct Professor and Mentor at IIT Hyderabad and is on Advisory board of public company in Ad-Tech space and on Board of NASDAQ listed Tripborn and various other startups.”

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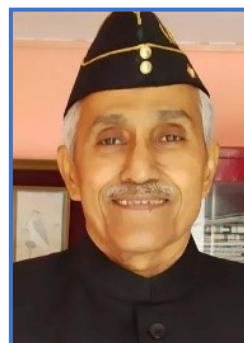
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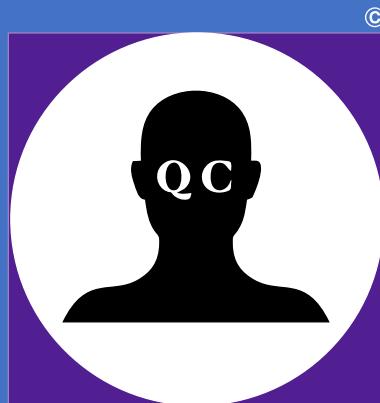
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