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CONTENTS

DOES THE HOLISTIC APPROACH CONSTITUTE A REALISTIC AND POSSIBLE OPTION FOR A FUTURE OF PROFOUND HUMAN KNOWLEDGE AND FOR A MODERN SCIENTIFIC RESEARCH?

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Abstract. *The holistic approach had old traditions in health research, especially. In the introduction to this article, the paradigm of holism is studied etymologically. First Holos is compared with Logos as notions generating completely different attitudes, passing through holism and holistic, with educational or academic and research or investigative accents, to finally reach the major meaning of holistic approach in human knowledge and scientific research. In a distinct section of this paper, the principles of this method of holistic approach are described, starting from the Gestalt Phenomenon and its derived theoretical notions. Another brief section exemplifies a major typology and exemplifies some holistic approaches. At the end of this paper, a few remarks provide adequate conclusive support for the future of education and scientific research according to the specific topic of the article.*

Keywords: *Holos, Logos, Holism, Holistic Approach, Gestalt Psychology, Gestalt Phenomenon (GP), Gestalt Principles (GPs), Laws of Perception, Academic Education (AE), Scientific Research (SR), Holistic Approaches* in *Academic Education* and *Scientific Research* (HAs AE&SR), *profound human knowledge.*

1. INTRODUCTION

The human knowledge and research had evolved from Mythos to Theos and Logos, and, finally, to Holos. The human profound evolution outlined in these four major and only apparently abbreviated steps, has lasted for mankind for a long interval of time that lasted more millennia. "*Thus, from Mythos, rooted in ancient myth and mythical consciousness, from which humanity took a first step towards Theos or the theist mixture, manifested with the appearance and existence of the pyramid-layered state and its theistic conscience, then passing through the Logos, the Word, which became essential in medieval times (continuously diversified in meanings and types of significance, from a quantitative logos to the theist one, or from the idealistic logos to the natural logos, finally moving from the mechanistic to the rational logos, to the relativist logos, etc.) and finally stopping in a Holos.*" (Savoiu, Manea, 2011) [1]. During this timeline, even "*Holos was initially difficult to predict, redefined through today's systemic, integrating approach, much-needed for salvation through knowledge and full, thorough research of nature, of the environment, of the ecosphere and, especially, of our human nature (holism being unimaginable outside the essential Socratic investigation sinthezised in the famous expression: know thyself).*" [Savoiu, Iorga, 2015, p. 4) [2]. The essence of the last transformation from Logos to Holos, based on holism and holistic approach in academic education and scientific research, covered almost entirely the last half of a century, since the 1970s, and is nearing the end in this third decade of the XXI century. This integral substitution from Logos to Holos was achieved by changing a set of values, especially educational and investigative values, with the obvious contribution of newer and original technologies to solve transdisciplinary and multi-disciplinary phenomena such as Big data, Internet of Things (hereafter: IoT) and, especially of the most complex phenomena, based on or through the Artificial Intelligence (hereafter: AI). An important role was also played by resources, multi-disciplinary methodologies, and transdisciplinary dialogues, especially those supported by a new mentality of the contemporary researcher and of the new and profound attitude to scientific knowledge:

Table no. 1: Landmarks of Logos turning into Holos, based on the holistic approach

Logos' specific signs	Holos' specific signs
Logos approaches, based on the word logos, became during the first six decades of the XX century a synthetic research, rational type of discourse, and even specific rationality, based on a central philosophic scientific and research concept especially. Logos, as the development of research, has finally yielded to intensive and emerging development, which was able to push society towards a new operating mode, of an aggregative, systemic and prepare the new holistic	Holistic approaches based on Holos in education & scientific research and overlap the principles that process raw materials or the units of unorganized world's energy, using these units, equipping all with specific structure and individuality. The Holistic approaches are divided into three manners of thinking to know the past, present and future. Holistic approaches based on a consciousness of Holos impose new types of education and integrative research for all academics

approach of research, inspired by scientific trans-disciplinarity of education and research.The transition from relativist logos to the current integrative Holos is a hope's vital sign in our times, plagued by a lot of uncertainties and risks.	and researchers in keeping with Confucius's principle of reciprocity: "*Treat all the others as you yourself wish to be treated*", turned by Gandhi, millennia later in: "*Be the change you wish to see in the world*", implicitly in the research world

Sources: Ghereş, M., Savoiu, G., (2010), Economia mediului. Tratat, Ed. Universitară, Bucureşti, pp. 347 – 348 [3], and Savoiu, G. Iorga – Siman, I. (2015). From Pseudo-Interdisciplinary Holism to Holistic Approach Based on Inter-, Trans-, Cross-, and Multidisciplinary Sciences and Research. *ESMSJ*, vol 5(2), p.6. [2].

Initiating a presentation of a *holistic approach* with the meaning of the word *holistic* is to discuss first of all about *Holos*, an ancient word with Greek origins. This old and original word generated a paradigm with many implications for education and research. It comes from an ancient Greek language and the first and the most expanded meaning was "*entire*" or "*all*". The original paradigm was viewed exclusively as an inflectional table or a table of notions, derived from the primary meaning of this *Holos*, as universal, from a universe equivalent to an ordered cosmos and not from chaos or from chaotic cosmos. In a purely linguistic investigative manner, some excerpts from some dictionaries of synonyms and antonyms (Fig. no.1 & 2) are relevant for the multitude of *pro significances* and for the variety of *anti meanings*, possessed by *Holos*, and its millennial paradigm.

absolute	alternative	full	overarching
abundant	ambitious	full-blown	plenary
accepted	ample	full-scale	profound
across-the-board	astrological	fully	related to holism
adequate	astronomical	general	relating to holism
aggregate	balanced	generalized	rounded
airy	ball-of-wax	global	supernaturalist
alimentative	based on holism	healthful	taken as a whole
all	basic	included	thorough
all together	big	inclusive	total
all-around	bird's-eye	inclusivity	unabridged
all-embracing	blanket	integral	uncondensed
all-encompassing	broad	integrated	uncut
alleviative	broader	international	undivided
all-in	bulk	large	unexpurgated
all-inclusive	catchall	mass	universal
all-out	common	multinational	unmitigated
all-over	complete	mystic	utter
all-pervading	comprehensive	new age	whole
all-pervasive	crystal healing	occult	wholemeal
all-present	embedded	of holism	wholesome
all-purpose	entire	one-size-fits-all	wholistic
all-round	exhaustive	outright	widespread
all-together	extensive	overall	world
			worldwide

Source: Realized by authors

Fig. 1. Some Modern Synonimes of *Holos* with the Significance of *Proholistic*

abbreviated	cut	fractional	minor
abridged	deficient	fragmental	narrow
atomistic	determinate	fragmentary	partial
atomistical	diffuse	fragmented	poor
based on organicism	diminished	inadequate	reduced
basic	disintegrated	incomplete	restricted
brief	divided	insignificant	scattered
circumscribed	exclusive	insufficient	separated
compact	finite	lean	short
customer-focused		limited	slight

Source: Realized by authors.

Fig. 2. Some Modern Antonyms of *Holos* with the Meaning of *Antiholistic*

The Greek word *holos* (ολοσ) means *entire* or *whole*. The similitude with the English word *whole* is rather an accident and not a certainty, and more important the identity of meaning is not a complete one. Even the Greek word *Holos* (ολοσ) comes from an Indo-European root *solo*, meaning whole, firm, sound, or correct. *Holos* also expresses the essence of modern *holism* just as "*the whole is greater than the sum of its parts*", being a term first used by Aristotle, initially with a synergistic meaning ["*The totality is not, as it were, a mere heap, but the whole is something besides the parts; there is a cause"* or "*the whole is not the same as the parts*"] and which can be found in Aristotle's Metaphysics, as an obsession for logic definition (Marc, 2016) [4]. This line of thought follows the thinking often attributed to Socrates: "*A disorderly mob is no more an army than a heap of building materials is a house*".

Redefined by Jan Smuts in 1926, *Holos* is already transformed into *holism*. *Holism* becomes the essence of *Gestalt theory* and generally it is opposed to the tendencies of analyzing, and breaking down the whole into parts. sometimes to the point where you "*can't see the forest for the trees*". The reborn term of *holism* was defined in Jan Smuts's journal, entitled *Holism & Evolution* (1926) as "*the tendency in nature to form wholes that are greater than the sum of constituent parts through creative evolution*". This conceptualization of a new *holism* is completed by the same South African general and statesman, Jan Smuts, with the finding that "*there is a tendency towards the whole even in the individual cells*" and with the idea of the existence of "*the reciprocal influence of the whole and its parts*", all these being able to create evolution (Smuts, 1926) [5].

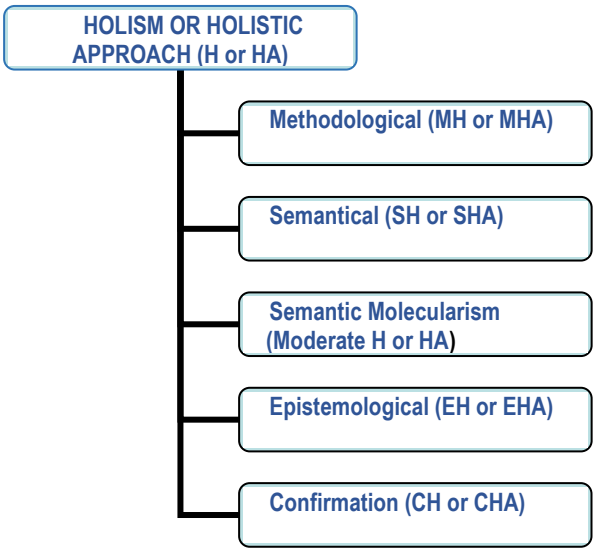
The conceptualization of the new *Holos* focuses on multidimensionality and transdisciplinarity, capitalizing on aggregative and integrative research (from purely physical to mathematical, economic, biological, social, psychological, educational, cultural, and other related) culminating in a harmonized adaptation of the human species as a whole (Bruner, 1970) [6], It has a dual focus on the i) limited type of adaptation of the individual, as well as the ii) development of new technologies,

methodologies, and research methods, as well as through a new vision on the modern research approach. *Holos* also imposes a new ethical approach structured on three levels, through the global ethics of scientific research, the specific ethics of research in a certain significantly differentiated scientific field, and the individual ethics of a simple researcher in his activity (fundamental, experimental, investigative, published, and so on) (Savoiu, Iorga, 2015, p. 6) [2]. Inside modern scientific research, *Holism*, derived from *Holos*, becomes more and more a specific view, "*denying that all large-scale social events and conditions are ultimately explicable in terms of the entities or individuals who participated in, enjoyed, or suffered them*" (Encyclopedia Britannica, 2010) [7]. In a dictionary explanation of *Holism* and *Holistic* significances, these words are *related to or concerned with wholes or with complete systems rather than with the analysis of, treatment of, or dissection into parts*" (Merriam-Webster, 2022) [8].

A modern *Holistic Approach* brings together all the information, data, and connections, going up to accidental references with a relative degree of relevance about the whole complex phenomenon observed, investigated, quantified, associated or correlated, anticipated evolutionarily and, finally, improving the scientific knowledge about it. The *Holistic Axis* of the modern research approach is generated by the idea that all parts of a complex system under investigation are interconnected.

2. GESTALT PHENOMENON AND DERIVED PRINCIPLES OF HOLISTIC APPROACH

Holism and *Holistic Approaches* already have a typology adequate to the specificity of the complex researched phenomenon as one can remark from fig. no. 3:



Source: Realized by authors from (Savoiu, Iorga, 2015, p. 5) [2].

Fig. 3. A typology of *Holism* or *Holistic Approach*

Methodological (*Holism* or *Holistic Approach*) means the complex phenomenon's study at its own autonomous macroscopic level, Semantical (H or HA) denies the claim of translation of the complex system without residue into statements about the actions and attitudes, associations and correlations of entities. Epistemological or confirmation (H or HA) appear and coexist in the case of new sciences that cannot be tested in isolation or unidisciplinary, but only in contact with and in their dependence on other sciences (based on inter-, multi- and transdisciplinarity) even calling on the entire language of scientific research. Moderate (H or HA) or Semantic Molecularism is an inevitable compromise with linguistic origins, trying to place holism within relatively broad knowledge and scientific research fields but not with the entire universe of knowledge and research (e.g. economic science). (Savoiu, Iorga, 2015, p. 5) [2].

The Holism and Holistic Approaches resulted in Gestalt Psychology (GP) in the 1950s, as a response to behaviourism. In a free and creative translation, the German word *Gestalt* (pronounced divided in "Ge + Shtalt") has the meaning of "*configuration, pattern, form or combination*" (*an arrangement of elements in a particular way of thinking*) sometimes even the clear significance of "*holism and structure*". Thus Gestalt tries to offer a solution for understanding the way individual elements or entities are integrated and structured by our cognition as a psychical whole using a *Holistic Approach* (Bustamante, 2021) [9].

Gestalt Psychology (hereafter: GP) is not only a school of thought considering all individuals in their social context but also a new way to investigate social complex phenomena for finding the specificity and understanding the impact in which the human brain perceives all its experiences as a whole. GP takes into account that specific properties characterizing individuals are different from the sum of their individual parts (in fact GP tends to apply the *Holist Approach* in Psychology).

Historically, the Gestalt school of thought has two significant influences of a purely philosophical nature in Kantian epistemology and in Husserl's phenomenological method. who tried to offer more knowledge about the individual consciousness, and also to understand through which mental processes a human individual forms a certain conception about the universe and the specific population in which he lives. (Jorge, 2010) [10]. Gestalt also has three outstanding researchers in Psychology as mentors, Max Wertheimer, and his inaugural article on Gestalt Psychology, titled *Experimental Studies of the Perception of Movement* (1912), Wolfgang Köhler especially for his book on *problem-solving*, entitled *The mentality of Apes* (1917), and Kurt Koffka with his famous book entitled *Principles of*

Gestalt psychology (1935). These three mature researchers and psychologists carefully observed the functioning of the human brain and formulated their original Gestalt theory and the principles derived from it.

The source of GP is also a new linguistic, and a new semantic attitude. Thus, when reading a text, one perceives each word and sentence as a whole with a holistic approach to identifying the real meaning, rather than seeing only individual letters. Finally, the purpose of the entire text depends on certain arrangements of letters in a specific structuring and grouping in words, expressions, sentences, phrases, etc. (Bustamante, 2021) [9]. Perhaps, the most important results of GP were *Gestalt Principles* (GPs), and *Laws of Perception*, explaining in detail how this behaviour of "*pattern - seeking*" operates in reality. They offer a powerful framework to understand how human perception works. They remain simple to assimilate and implement even today (Fig. no. 4), being used not only in Psychology, but also in Arts, by visual artists, in Education, by teachers and educators and yet in Bussines Comunication.

PRINCIPLE'S-IMAGE (STANDARD GRAPH)	PRINCIPLES' ESSENCE (WORDS' CONTOUR)
 PROXIMITY	**PROXIMITY** can be applied when objects placed together, and the eye perceives them as a group.
 SIMILARITY	**SIMILARITY** appears when objects look similar to one another, and the eye perceives them as a group or pattern.
 CONTINUANCE	**CONTINUANCE** comes out when the eye is compelled to move from one object through another.
 CLOSURE	**CLOSURE** arises always when an object is incomplete or is not completely and clearly enclosed.
 FIGURE & GROUND	**FIGURE & GROUND** emerges when the eye differentiates an object from its surrounding surface or area.

Source: Realized by authors

Fig. 4. A synthesis of *Gestalt Principles* (GPs)

The *Laws of Perception* and other more detailed classifications include supplementary: i) *prägnanz*, which called the "*law of simplicity*" or "*law of good figure*"; ii) *common region*, which proposes that elements located within the same closed region to be perceived as belonging to the same group: iii) *symmetry* according to which symmetrical components are grouped together; iv) *common faith*, when elements tend to be perceived as grouped together if they move together, etc. (Dresp-Langley, 2015) [11].

Gestalt and its own experimental research appear as a scientific Psychology in European Universities during the early decades of the 20th century, being closely linked to German thinking and to some of its most representative epistemological theories. Gestalt psychologists offered some answers and gave contours to the basis of phenomenism. Holism, holistic approach and structuralism provide scientific explanations for why changes in spacing, organization and timing can radically transform how information is received and assimilated in the human brain or mind.

In Gestalt theory, *Holistic Approach* means to provide support that looks at the entire or whole phenomenon including all explanatory variables (e. g. Universe, Terra, Mankind, Human body, Global Economy, Education, Research, and other related), and not just their reduced parts or small entities' factors or causes.

Holistic Approach appears in Gestalt Psychology because of its central tenet based on those "mental shortcuts", able to understand the perception of the whole as different from the sum of individual elements (the whole being different from the sum of its parts). Gestalt sustains the opposite path of the general idea that the complex perceptions become clear only by identifying the primitive sensations it caused, and suggests, the whole is grasped even before the brain perceives the individual parts (e.g. looking to a photograph, one sees the image of a face rather than a nose, two eyes and the shape of a chin, etc.), and this is the explained human brain reality: human mind or brain transcends the specific parts to focus on the whole, loosing somehow its objectivity.

In science, *Holism* and *Holistic Approach* seem to be somehow limited for only one researcher, but unlimited for one selected and extended team of researchers.

Holism and *Holistic Approach* do offer great satisfaction and advantages in modern research, directing theoretically and leading practically everything towards pure originality, beauty, truth and specific values of knowledge and satisfaction in complex investigation for scientific research themselves (Savoiu, 2013) [12].

Contemporary *Holos*, on which more integrative *Holism* and *Holistic Approach* are based, cannot be complete before academic education and scientific research are able to solve the issues of priorities for knowledge in teaching students, and in major investigations for the human population.

3. A MAJOR HOLISTIC APPROACHES' TYPOLOGY AND SOME EXAMPLES

Holistic Approaches in *Academic Education* and *Scientific Research* (hereafter: HAs AE&SR) have their real roots or basic sources in Gestalt Psychology with its principles and the Laws of Perception. HAs AE&SR influenced and will still influence modern education and research in a multitude of disciplines, from linguistics, to design, from architecture to visual communication, from economics, to politics, from biology, to human and veterinary medicine, from marketing to antimarketing, from permaculture to organic farming, from holistic management to quantum physics, from antropology to telelology, etc.Thus, for the authors of this paper, HAs AE&SR are in fact integrated forms of multi- and trans-disciplinarity and offer many advantages for a scientific investigation, such as: integration, aggregation, comprehensibility, universality, and full-inclusion in new knowledge about complex phenomena.

The first exemplification of two different types of HAs AE&SR identify distinctive HAs in qualitative and quantitative researche. Some significant differences between qualitative research (QLR) and quantitative research (QTR) are shown in fig. no. 5:

QUALITATIVE RESEARCH (QLR)	QUANTITATIVE RESEARCH (QTR)
Data collected are words or images	Data collected are numbers
Small-scale studies are associated with it	Larger-scale studies are associated with it
Looks in-depth at some phenomenon	Aims to collect&generalise large data amount
Tends to take a holistic perspective	Tends to look at specific variables
Data analysis is placed throughout the data collection	Concentrates on data analysis after it has been collected.
QLR relies on researcher directly involved	QTR relies on researcher more detached & objective

Source: Realized by authors from (Denscombe, 2021, pp. 47-49) [13].

Fig. 5. Some distinctions between QLR and QTR

Holistic Approach means to look at phenomenon as a whole interconnected entity, and thus to understand the bigger picture. *Holistic Approach* tries not only to think outside "*the box*" but also to remove "*the box*" completely. Finally, HAs AE&SR are qualitative when their holistic approaches are more visible and essential, whereas HAs AE&SR are quantitative as soon as become much more particularistic. Moreover, HAs AE&SR quantitative suggest a final course of action and HAs AE&SR qualitative research develop the initial understanding. (Collins, 1992, pp. 181-186) [14].

Some examples of HAs AE&SR. constitute the final part of this section, having the role of concretizing the theoretical notions in the article.

Holistic Approach in medicine tries to prevents and offers therapeutic solutions for a better health and applied medicine, thus emphasising the necessity of examining a person in whole, including his body, mind, feelings, and its environment, and not only some isolated organs, functions etc. The term *Holistic Approach in medicine* or simply *Holistic Medicine* appeared in the late of the XX century and its *International Association of Holistic Health Practitioners* was founded in 1970, assuming its current holistic name after more than one decade, in 1981 (Encyclopedia Britannica, 2020) [15].

There is also a *Holistic Approach* in therapy, well-known as *Gestalt Therapy*, which Frederick and Laura Perls founded in the 1940s. It focuses on the phenomenological method of awareness that distinguishes perceptions, feelings and actions from their interpretations. Gestalt Therapy considers that explanations and interpretations are less reliable than what is directly perceived and felt, and thus it generates a therapy rooted in dialogue, in which patients and therapists discuss not only conceptual and concrete differences, but also the real perspectives of good health (Yontef & Simkin (1981) [16].

Holistic Approach in design was described aas a reality in modern research by Gregg Berryman in his book, *Notes on Graphic Design and Visual Communication* (1979) [17]. In fact, modern design just applies Gestalt principles and laws redefining many of perceptual factors and rebuilding a visual frame of references, providing young designers with a "*reliable psychological basis for the spatial organization of graphic information*". *Holistic Approach in design* becomes more and more useful in the creation of posters, magazines, logos and billboards in a meaningful and organized way. Recently, *Holistic Approach in design* "*has also been applied to the design of websites, user interfaces and digital experiences*" (Graham, 2002; 2008) [18, 19].

Holistic Approach in education, represents forms of applied *Gestalt Theory* as a natural reaction to behaviorism, and suggests that students can perceive the whole of the learning goal, and only after this profound understanding they will discover the relations between entities and the entire system, but teachers must provide structured lesson's framework and only after this action they can explain into details, revealing based on Gestalt principles the relation between contents and the major lesson's purpose (Bustamante, 2021) [9].

Holistic Approach to organisation is a direct contradiction of the last century's direction of organisation. Based more on Logos than on Holos, XXth century organisation is founded on the

particularisation of work by job division. Inherited from the Greco-Roman tradition of trireme building and passed by Venetian Arsenal and Adam Smith's pin manufacture example, it was perfected in Ford Motor Company, where specialization of work enabled mass production of motor cars [20]. While the coordination was concentrated in a few positions from technostructure and top management, the rest of the organizations' tasks were as far from the holistic as possible, so this approach can be dubbed "anti-holistic". Becoming one of the major drives of economic progress in the last century [21] it also leads to a wide array of problems with job satisfaction, alienation [22] and problems which can be detected on the global scale [23]. Opposed to that approach is research rooted on earlier works of Adizes [24], Mintzberg [25] and Senge [26], currently articulated in the theory of "teal organisation" of Frederich Lalaux [27]. It describes a self-management team approach based on the holistic work perception and despecialization of work.

Holistic Approach to innovation management in banking is an example of Holos that ensures a strong foundation for a better understanding of the dynamics in banking, an effective response to all the challenges that the global marketplace is exposed to and a valuable source for new business opportunities aimed at creating a sustainable competitive advantage in banking services [31]. Tornjanski et al. (2015) [31] have concluded that traditional forms of innovation management in banking do not contribute to sustainability. Contrarly, new approaches with a holistic view and systematic acting should be taken into account [45], as well as the adoption of effective instruments and structures with the purpose to energize superior value creation for customers and stakeholders.

Holistic Approach to the ecosystem represents a multidimensional concept founded on various "assets" that (inter)act in an integrated manner to boost the efficiency and effectiveness of desired outcomes for all involved parties. The existing theoretical fund contains numerous examples of a holistic approach to a ecosystem phenomena. To name just a few: entrepreneurial ecosystem [32], (e)learning ecosystem [33], open innovation ecosystem [34], collective intelligence ecosystem [35], privacy protection ecosystem [36], secured digital business ecosystem [37].

Holistic Approach in the context of Society 5.0 is a dimension developed in Japan in 2016. with the aim to design a "super smart society" for the world. The concept, bright vision and growth strategy are designed for a sustainable future, founded on human-centricity, prosperity and well-being for all [35], [38-44].

Depicted examples signify the weight of the Holos approach that should be taken into account for further development in science and research areas.

4. SOME FINAL REMARKS

The authors of this paper consider education and research as the human activities able to expand the human knowledge in universe.

Holistic Approach remains that of benevolent cooperation and competitive trust as guiding criteria for optimizing education, research, resources, consumer satisfaction, housing, health, culture, sociability, etc. by researching the social, spiritual, political, economic, technological, demographic and ecological aspects of life, transforming violence and absurd competition into inadequate or even impossible solutions.

The *holistic approaches in academic education and scientific research* (HAs AE&SR) did not disappear at all after Socrates' simple and valid observation that an individual cannot know everything. The modern team of researchers familiar with the holistic approach in the new multi- and transdisciplinary horizon of current sciences or methodological holism is becoming more and more clearly the optimal option that emphasizes the importance of studying complex systems as integrative and coherent systems whose component parts can be much better known and understood both in relation to each other, and in their relation to the whole or system. The *Antiholism* error characterizes the limited and unidirectional and isolating approaches in the investigation of complex systems or living organisms, and this error cannot be completely removed by knowing only the parts, entities and individual characteristics. The excess of atomism will be eliminated by the holistic approach in very near future…

The approach of triple bottom line in management and economy illustrates science-oriented holism [28] as the hypothesis of business performance is tested against financial, environmental and social data (which in other cases can be extended by e.g. political, historical or emotional context). This opposes antiscientific holism which dubs all hypothesis beyond empirical testing… The modern *Holistic Approach* is identical with integrative science according to Kafatos and Drăgănescu. They have used the concept of integrative science as a result of the expansion of contemporary holism (Iordache, 2008, p. 215) [28].

"*Integrative science is reconsidered as a way of scientific and Luciferic knowing and research with a dominantly transverse or transdisciplinary sense, and not a paradise-like one* (in the meaning Romanian philosopher Lucian Blaga gave that antinomy of knowledge in itself), *and even simultaneously paradise-like and Luciferic* [...] *Integrative science is simultaneously horizontal or*

inter- and transdisciplinary, using transversality, also articulating, through this integration, cross- and multi- disciplinarity into scientific research (Kafatos and Drăgănescu, 2003, pp.11-23) [29]. *Mihai Drăgănescu styled this type of science and scientific research by the name of orthophysics, and Amoroso by Noethic theory* (Amoroso, 2001) [30],

Thus, *Holistic Approach's* performance in education and research gradually become fundamental indicators not only in the contemporary context, but especially in the future, and the character of this new integrative science turns into the aspiration of scientific knowledge.

All the holistic approaches in academic education and modern research reality are less and less of the one-sided type, but more and more of multi-, and trans-disciplinary knowledge and investigation, and, no doubt, the need is increasingly felt for continuous approaches of the multi-, and trans-disciplinary human survival based on knowledge, and modern research.

"The importance of the education and research team work and through academic and research projects, along with the obvious obsolescence of unidirectional or exclusive observation, and the ultimate goal is also one of adequacy within today's globalized, political, economical and social context" (Săvoiu, Iorga 2015, p.7) [2].

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ON SOME EXISTENCE AND UNIQUENESS RESULTS FOR NONLINEAR FRACTIONAL DIFFERENTIAL EQUATIONS WITH BOUNDARY CONDITIONS

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Abstract. In this paper we have discussed a boundary value problem involving Caputo nonlinear fractional integro-differential equations of order $0 < \alpha \leq 1$ *and* $0 < \beta \leq 1$ *with boundary conditions of the form* $x(0) = x(1) = 0$. *We have proved some new existence and uniqueness results by using the fixed point theory. In particular, we have used the Banach contraction mapping principle and Krasnoselskii's fixed point theorem under some weak conditions. The results proved are supported by means of a couple of examples.*

Keywords: Riemann-Liouville fractional derivative, Caputo fractional differential equation, Banach contraction principle, Krasnoselskii's fixed point theorem

MSC2020-Mathematics Subject Classification:34B15

1. INTRODUCTION:

After the wide and successful applicability of the theory of differential equations in the fields of Applied Mathematics, Mathematical Physics, Chemical Sciences, Biological Sciences, Engineering and Technology, etc., the theory of fractional calculus has attracted the attention of many researchers because of the applicability of the derivatives and integrals of the fractional order with the corresponding initial and boundary conditions. Besides all the fields of sciences and technology as mentioned earlier, the theory of fractional calculus is being applied to Fluid Dynamics, Electromagnetism, Viscoelasticity, the Analysis of the Feedback Amplifiers and Capacitors, etc. In last few decades, many of the researchers have pointed out that the fractional order differentials and integrals are of special importance in order to describe the viscoelastic properties of the real materials like polymers. In this paper, we have considered the existence and uniqueness of solutions for the following problem:

$$D^{\alpha}D^{\beta}x(t) = f\big(t, x(t), \phi x(t), \psi x(t)\big), t\epsilon[0,1] \quad . \quad . \quad . (1)$$
$$x(0) = x(1) = 0$$

where $0 < \alpha \leq 1, 0 < \beta \leq 1$, D^{α}, D^{β}, are the Caputo fractional derivatives of order α , β, $f : [0,1] \times R^3 \longrightarrow R$ is a continuous function, and

$$\phi x(t) = \int_0^t \lambda(t,s)x(s)ds \quad . \quad . \quad . \qquad (2)$$

$$\psi x(t) = \int_0^t \delta(t,s)x(s)ds \quad . \quad . \quad . \qquad (3)$$

where λ, δ:[0,1]×[0, 1]→[0,+∞) with

$$\phi^* = Sup_{t\in[0,1]} \left| \int_0^t \lambda(t,s)ds \right| < \infty \quad . \quad . \quad . \quad (4)$$

$$\psi^* = Sup_{t\in[0,1]} \left| \int_0^t \delta(t,s)ds \right| < \infty \quad . \quad . \quad . \quad (5)$$

Before proving the existence of the solution to the boundary value problem (1–5), we will take a review of the basic definitions and the notions required for the understanding of these results in the next section.

2. A REVIEW OF PRELIMINARY CONCEPTS AND RESULTS

Leibnitz discussed the fractional derivative of order 1.5 in his notes to L'Hospital back in the year 1695. Joseph Fourier in 1822 gave an expression for a fractional order derivative[1] obtained from the Fourier integral representation of a function in the form

$$\frac{d^u[f(x)]}{dx^u} = \frac{1}{2\pi} \int_{-\infty}^{\infty} f(\alpha)d\alpha \int_{-\infty}^{\infty} p^u \cos\left[p(x-a) + \frac{u\pi}{2}\right] dp$$

The first major study of fractional calculus was made by Liouville in 1833 who gave two definitions of fractional order derivatives as follows. The arbitrary derivative $D^{\nu}$of order ν of a function $f(x)$ having power series expansion

$$f(x) = \sum_{n=0}^{\infty} c_n e^{a_n x}, \qquad Re(a_n) > 0$$

is given by

$$D^{\nu}[f(x)] = \sum_{n=0}^{\infty} c_n a_n{}^{\nu} e^{a_n x}$$

Because of the restrictions on the function $f(x)$, Liouville [2] gave his second definition involving the gamma function in the form

$$D^{\nu} x^{-a} = \frac{(-1)^{\nu}}{\Gamma(a)} \int_0^{\infty} u^{a+\nu-1} e^{-xu}\, du$$

$$= \frac{(-1)^{\nu}\Gamma(a+\nu)}{\Gamma(a)} x^{-a-\nu}, \qquad a > 0$$

The second definition given by Liouville is too narrow as it applies only to the functions of the form $f(x) = x^{-a}$, $a > 0$. Using the generalization of the Taylor series expansion of a function, Bernhard Riemann[2] defined the fractional derivative of order ν as

$$D^{-\nu} f(x) = \frac{1}{\Gamma(\nu)} \int_c^x (x-t)^{\nu-1} f(t)\, dt + \psi(x)$$

where Riemann added a complementary function $\psi(x)$ as the lower limit of the integration c was unclear. The difficulty in the applicability of the Riemann's definition was pointed out by A. Cayley since it was unclear what will be the meaning of the complementary function $\psi(x)$ if $\psi(x)$ has an infinite arbitrary constants.

As a modern approach towards defining the fractional order derivative, we use the Riemann-Liouville definition of the fractional order derivative of a function $f(t)$ defined on the closed interval $[a, t]$ and having the $(m+1)$th continuous derivative $f^{(m+1)}(t)$. The Riemann-Liouville derivative [2, 3, 4, 5] of fractional order α is given by

$$D_t^p[f(t)] = \frac{\mathrm{d}^{(\mathrm{m}+1)}}{\mathrm{dt}^{(\mathrm{m}+1)}} \int_a^t (t-\tau)^{(m-p)} f(\tau)\, d\tau$$

where $m \le p < m+1$. The initial value problem involving Riemann-Liouville fractional derivative are practically not useful as there is no physical interpretation of such types of initial conditions.

The general approach suggested by M. Caputo is useful for the formulation of initial value problems involving the fractional differential and integral equations. Caputo's definition [2] of the derivative of fractional order α is given by

$${}_a^C D_t^{\alpha}[f(t)] = \frac{1}{\Gamma(\alpha-n)} \int_a^t \frac{f^{(n)}(\tau)}{(t-\tau)^{\alpha+1-n}}\, d\tau$$

It is clear that as $\alpha \to n$, the the Caputo's definition becomes the conventional definition of the nth order $f^{(n)}(t)$. The main advantage of Caputo's definition is that the initial conditions for the fractional differential equations with Caputo derivatives take on the same form as the integer order differential equations. We make a slight change in the notation for Caputo fractional derivative and define the Caputo derivative of order $\alpha > 0$ with the lower limit zero for a function f as

$$D^{\alpha} f(t) = \frac{1}{\Gamma(n-\alpha)} \int_a^t (t-\tau)^{n-\alpha-1} f^{(n)}(\tau)\, d\tau$$

where n is a positive integer, $0 \le n-1 < \alpha < n$ and $t > 0$. The fractional integral of order $\alpha > 0$ with the lower limit zero for a function f is defined as

$$I^{\alpha} f(t) = \frac{1}{\Gamma(\alpha)} \int_0^t (t-\tau)^{\alpha-1} f(\tau)\, d\tau$$

In [6], by the application of Krasnoselskii Fixed point theorem, Agarwal et al. have proved the existence of at least one solution to the initial value problem of fractional neural functional differential equation given by

$$D_C^{\alpha}[x(t) - f(t, x_t)] = f(t, x_t), \qquad t \in (t_0, \infty), t_0 \ge 0$$

$$x_{t_0} = \phi$$

where D_C^{α} is the Caputo fractional derivative of order α, $0 < \alpha < 1$, f and g are functions defined on $[t_0, 1) \times C([-r, 0],\ R^n) \to R^n$, $\phi \in C([-r, 0],\ R^n)$, $a > 0$. In [7], Fang Li has proved the existence and uniqueness of mild solutions in a Banach space X for the fractional differential equation of the form

$$\frac{d^q}{dt^q}[x(t)] = -A\, x(t) + f\big(t, x(t), Gx(t)\big), \qquad t \in [0, T]$$

under the conditions

$$x(0) + g(x) = x_0, \qquad 0 < q < 1, \qquad T > 0$$

where it is assumed that $-A$ generates an analytic semi-group $\{s_t\}_{t \ge 0}$ of uniformly bounded linear operators on the space X, the operator $Gx(t)$ is defined by

$$G\,x(t) = \int_0^t k(t,s)\,x(s)\,ds$$

where K is a positive function defined on the set $D = \{(t,\ s)\ \in\ R2\ :0\ \leq\ s\ \leq\ t\ \leq\ T\}$ and

$$G^* = \sup_{t\in[0,\ T]} \int_0^t k(t,s)\ ds < \infty$$

Ahmad et al.[8, 9], have obtained the solutions of the integrodifferential equations with non-local four point and strip multipoint boundary conditions. Wang et al. in [10] have established the conditions for the uniqueness and existence of the positive solutions of the fractional integrodifferential equation

$$D^{\alpha}u(t) + f\big(t, u(t), Tu(t), Su(t)\big) = 0, \qquad 0 < t < 1$$

under the boundary conditions given by

$$\begin{aligned} u(0) = u_0, u'(0) =\ & b_1, \dots, u^{(n-3)}(0) \\ & = b_{n-3}, u^{(n-2)}(0) = b_{n-2}, u^{(n-1)}(0) \\ & = b_{n-1} \end{aligned}$$

where $n-1 < \alpha \leq n,\ 0 \leq \mu < n-1,\ n \geq 3,$ $bi \geq 0\ (i = 1,\ 2, \dots,\ n-3,\ n-2,\ n-1),$ D^{α} being the Caputo fractional derivative of order α, f is a continuous function from $[0,\ 1] \times R3 + R_+^3 \to R_+,\ T$ and S are defined by

$$(Tx)(t) = \int_0^1 K(t,s)\,x(s)\,ds, \quad (Sx)(t)$$

$$= \int_0^1 H(t,s)\,x(s)\,ds$$

$$K^* = \sup_{t\in[0,\ 1]} \int_0^t K(t,s)\ ds,$$

$$H^* = \sup_{t\in[0,\ 1]} \int_0^t H(t,s)\ ds$$

where $K \in C(D,\ R^+),\ H \in C([0,1] \times\ [0,1],\ R^+).$

Many more others like Hilal et al. [11, 12] also have obtained the results stating the existence and uniqueness of the solutions of the fractional integro-differential equations under different boundary conditions. In [13], A. Bragdi et al. obtained the solution of the BVP given by $D^{\alpha}\big(D^{\beta}\big)u(t) = f\big(t, u(t), \phi u(t), \psi u(t)\big)$ under the boundary conditions given by

$$u(1) = u(0) =\ u'(0) = 0$$

where it is assumed that $1 < \alpha \leq 2,\ 0 < \beta \leq 1,$ $f : I \times R^3 \to R,\ I = [0,\ 1],$ the function f is continuous and

$$\phi(u)(t) = \int_0^t \gamma(t,s)u(s)\ ds, \quad \psi(u)(t)$$

$$= \int_0^t \lambda(t,s)u(s)\ ds$$

$$sup \int_0^1 \lambda(t,s)\ ds < \infty, \qquad sup \int_0^1 \gamma(t,s)\ ds < \infty$$

where $\gamma, \lambda : I \times I \to [0,1)$

In [14], Ibnelazyz L et al. have explored the existence and uniqueness for a nonlinear fractional integro-differential equations with integral and anti-periodic boundary conditions where the existence is proved by means of Krasnoselskii's fixed point theorem and the uniqueness of solutions is established via the Banach's contraction principle. In [15], M. J. Mardanov et al. have obtained the unique solution for the BVP

$$D_{0^+}^{\alpha}\,x(t) = f\big(t, x(t), \phi\,x(t), \psi\,x(t)\big), t \in [0,T]$$

under the boundary conditions described by

$$Ax(0) = \int_0^T n(t)x(t)dt = C$$

where $0 < \alpha < 1,\ D_{0^+}^{\alpha}$ is the Caputo fractional derivative of order $\alpha, A \in R^{n\times n}$, $n(t)$ is a function $[0,T] \to R^{n\times n}$. The other terms are defined by

$$N = A + \int_0^T n(t)dt\,, \qquad det(N) \neq 0$$

$$\phi(x)(t) = \int_0^t \lambda(t,s)x(s)ds\,, \ \psi(x)(t)$$

$$= \int_0^T \gamma(t,s)x(s)ds$$

where

μ, λ: $[0,T] \times [0,T] \to\ R^{n\times n}$,

$$\mu_0 = max\,||\mu(t,s)||, \lambda_0 = max\,||\mu(t,s)||, \quad t,s \in [0,T]$$

3. MAIN RESULTS

In this section we will prove the existence of the solution of the initial value problem (1-5). First we mention some of the important results required.

Theorem 1. [16] *Let Ω be a closed, convex, and bounded nonempty subset of a Banach space X. Let A and B be two operators such that*
(i) $Ax + By \in \Omega$ whenever $x, y \in \Omega$
(ii) A is compact and continuous
(iii) B is a contraction mapping
Then, there exists $z \in \Omega$ such that $z = Az + Bz$.

Theorem 2. [3] *Let $\alpha, \beta \geq 0$.Then the following relation hold*

$$I^{\alpha} t^{\beta} = \frac{\Gamma(\beta+1)}{\Gamma(\alpha+\beta+1)} t^{\alpha+\beta}$$

Theorem 3. [3] *Let n be a positive integer and $n-1 < \alpha < n$. If f is a continuous function then we have*

$$I^{\alpha} D^{\alpha}[f(t)] = f(t) + a_0 + a_1 t + a_2 t^2 + \cdots + a_{n-1} t^{n-1}$$

Theorem 4. *Let $f \in C([0,1], R)$ then the unique solution to the initial value Problem*

$$D^{\alpha} D^{\beta} x(t) = f(t), \qquad t \epsilon [0,1]$$

$$x(0) = x(1) = 0$$

is given by

$$x(t) = \frac{1}{\Gamma(\alpha+\beta)} \int_0^t (t-\tau)^{\alpha+\beta-1} f(\tau) d\tau - \frac{t^{\beta}}{\Gamma(\alpha+\beta)} \int_0^1 (1-\tau)^{\alpha+\beta-1} f(\tau) d\tau$$

Proof: By applying theorem 3, we have

$$D^{\beta} x(t) = I^{\alpha} f(t) + a_0$$

$$x(t) = I^{\alpha+\beta} f(t) + I^{\beta} a_0 + a_1$$

where $a_0, a_1 \in R$.

Hence

$$x(t) = \frac{1}{\Gamma(\alpha+\beta)} \int_0^t (t-\tau)^{\alpha+\beta-1} f(\tau) d\tau + \frac{t^{\beta}}{\Gamma(\beta+1)} a_0 + a_1$$

and by using the condition $x(0) = 0$, we obtain $a_1 = 0$ and by using $x(1) = 0$ we get

$$a_0 = -\frac{\Gamma(\beta+1)}{\Gamma(\alpha+\beta)} \int_0^1 (1-s)^{\alpha+\beta-1} f(\tau) d\tau$$

By substituting the value of a_0, we get

$x(t) = \frac{1}{\Gamma(\alpha+\beta)} \int_0^t (t-\tau)^{\alpha+\beta-1} f(\tau) d\tau - \frac{t^{\beta}}{\Gamma(\alpha+\beta)} \int_0^1 (1-\tau)^{\alpha+\beta-1} f(\tau) d\tau$.

The converse can be easily verified by direct computations. ■

Theorem 5. (Main Result: Existence of the Solution)

Let X be the Banach space of all continuous function from $[0,1] \to R$ induced with the norm

$\|y\| = sup_{t \in [0,1]} \{|y(t)| : t \in [0,1]$ and $\|y\|_{\mu} = sup_{t \in [0,1]} \left(\frac{y(t)}{e^{\mu t}}\right)$

where $\mu > \left(1 + \phi^* + \psi^*\right)\Gamma(\alpha+\beta)\big)\|\sigma\|, \sigma \in C([0,1]; [0,\infty))$.

Suppose that

1. $\left|f\left(t, x_1, x_2, x_{3,}\right) - f\left(t, y_1, y_2, y_{3,}\right)\right|$

$\leq \sigma(t)(|x_1 - y_1| + |x_2 - y_2| + |x_3 - y_3|)$

for all $t \in [0,1]$ and $x_1, x_2, x_{3,} y_1, y_2, y_3 \in R$.

2. $|f(t,x,y,z)| \leq k(t)$

$\forall\, (t,x,y,z) \in [0,1] \times R^3, \;\; k \in C([0,1]; R^+)$

Then the initial value problem (1-5) has at least one solution.

Proof: Consider an ϵ-sphere $B_{\epsilon} = \left\{y \in X : \|y\|_{\mu} \leq \epsilon\right\}$ with

$$\epsilon \geq \frac{\|k\|}{\mu} \left(\frac{e^{\mu} - 1}{\Gamma(\alpha+\beta)}\right) + \frac{1}{\Gamma(\alpha+\beta)}$$

We define two operators A and B on B_{ϵ} by the relations

$$A_{x(t)} = \frac{1}{\Gamma(\alpha+\beta)} \times$$

$$\int_0^t (t-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\, d\tau$$

$$B_{y(t)} = -\frac{t^{\beta}}{\Gamma(\alpha+\beta)} \times$$

$$\int_0^1 (1-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\, d\tau$$

For $x, y \in B_{\epsilon}$, we have

$$\begin{aligned}
&\left\|A_{x(t)}\right\|_{\mu} \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \left| \frac{1}{\Gamma(\alpha+\beta)} \right. \\
&\left. \times \int_0^t (t-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\, d\tau \right| \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{1}{\Gamma(\alpha+\beta)} \int_0^t (t-\tau)^{\alpha+\beta-1} |k(\tau)| d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{1}{\Gamma(\alpha+\beta)} \times \\
&\int_0^t (t-\tau)^{\alpha+\beta-1} |k(\tau)| \frac{e^{\mu\tau}}{e^{\mu\tau}} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \int_0^t (t-\tau)^{\alpha+\beta-1} e^{\mu\tau} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \int_0^t e^{\mu\tau} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \frac{e^{\mu t}-1}{\mu} \\
&\leq \frac{1}{\mu} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \frac{e^{\mu t}-1}{e^{\mu t}} \\
&\leq \frac{\|k\|_{\mu}}{\mu} \frac{e^{\mu}-1}{\Gamma(\alpha+\beta)}
\end{aligned}$$

Also, we have

$$\begin{aligned}
&\left\|B_{y(t)}\right\|_{\mu} \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \left| -\frac{t^{\beta}}{\Gamma(\alpha+\beta)} \right. \\
&\left. \times \int_0^1 (1-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\, d\tau \right| \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \left| \frac{t^{\beta}}{\Gamma(\alpha+\beta)} \right. \\
&\left. \times \int_0^1 (1-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big) d\tau \right| \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{1}{\Gamma(\alpha+\beta)} \int_0^1 (1-\tau)^{\alpha+\beta-1} k(\tau) \frac{e^{\mu\tau}}{e^{\mu\tau}} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \int_0^1 (1-\tau)^{\alpha+\beta-1} e^{\mu\tau} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \int_0^1 e^{\mu\tau} d\tau \\
&\leq sup_{t\in[0,1]} \frac{1}{e^{\mu t}} \frac{\|k\|_{\mu}}{\Gamma(\alpha+\beta)} \frac{e^{\mu}-1}{\mu} \\
&\leq \frac{\|k\|_{\mu}}{\mu} \frac{e^{\mu}-1}{\Gamma(\alpha+\beta)}
\end{aligned}$$

Therefore

$$\left\|A_{x(t)} + B_{x(t)}\right\|_{\mu} \leq \frac{\|k\|_{\mu}}{\mu} \left[\frac{e^{\mu}-1}{\Gamma(\alpha+\beta)} + \frac{1}{\Gamma(\alpha+\beta)}\right]$$

This proves that $xA + yB \in B_{\epsilon}$.

Now we prove that A is a contraction mapping. For $x, y \in B_{\epsilon}$, we have

$$\begin{aligned}
&\left\|A_{y(t)} - A_{x(t)}\right\|_{\mu} \\
&\leq \sup \frac{1}{\Gamma(\alpha+\beta) e^{\mu t}} \int_0^t (t-\tau)^{\alpha+\beta-1} \\
&\times \left| f\big(\tau, y(\tau), \phi y(\tau), \psi y(\tau)\big) \right. \\
&\qquad \left. - f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big) \right| d\tau \\
&\leq \sup \frac{1}{\Gamma(\alpha+\beta) e^{\mu t}} \int_0^t (t-\tau)^{\alpha+\beta-1} \\
&\times \sigma(\tau)[\, |y(\tau) - x(\tau)| + |\phi y(\tau) - \phi x(\tau)| \\
&\qquad + |\psi y(\tau) - \psi x(\tau)|]\, d\tau \\
&\leq sup_{t\in[0,1]} \frac{\|\sigma\|}{\Gamma(\alpha+\beta) e^{\mu t}} \int_0^t e^{\mu\tau} \left[\|y - x\|_{\mu} \right. \\
&\qquad \left. + \phi^* \|y - x\|_{\mu} + \psi^* \|y - x\|_{\mu}\right] d\tau \\
&\leq sup_{t\in[0,1]} \frac{(1 + \phi^* + \psi^*)\|\sigma\|}{\Gamma(\alpha+\beta)} \frac{e^{\mu t}-1}{e^{\mu t}} \left[\|y - x\|_{\mu}\right]
\end{aligned}$$

$$\leq sup_{t\in[0,1]} \frac{(1+\phi^*+\psi^*)\|\sigma\|}{\Gamma(\alpha+\beta)} \ \left[\|y-x\|_\mu\right]$$

From the definition of the new norm, we conclude that A is a contraction mapping. Moreover, the continuity of the function f implies that B is compact and continuous. Also B is uniformly bounded on B_ϵ since

$$\left\|B_{y(t)}\right\|_\mu \leq \frac{\|k\|_\mu}{\mu} \frac{e^\mu - 1}{\Gamma(\alpha+\beta)}$$

Suppose that $0 \leq t_1 \leq t_2 \leq 1$. Then we have

$$\begin{aligned}&\left|B_{y(t_2)} - B_{y(t_1)}\right| \\ &\leq \frac{\left|{t_2}^\beta - {t_1}^\beta\right|}{\Gamma(\alpha+\beta)} \\ &\times \int_0^1 (1-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)d\tau\end{aligned}$$

As $t_1 \to t_2$ independently, we conclude that

$\left|B_{y(t_2)} - B_{y(t_1)}\right| \to 0$ since $y \in B_\epsilon$.

This shows that the operator B is relatively Compact on B_ϵ. Thus, by the Arzela Ascoli theorem[17], we conclude that B is compact on B_ϵ. By the Krasnoselskii fixed point theorem[17, 18], it follows that the initial value problem (1-5) has at least one solution on B_ϵ.

Theorem 6. (Main Result: Uniqueness of the Solution)

Suppose that $f: [0,1] \times R^3 \to R$ is a continuous function satisfying

$$\left|f\big(t, x_1, x_2, x_{3,}\big) - f\big(t, y_1, y_2, y_{3,}\big)\right|$$

$$\leq \sigma(t)(|x_1 - y_1| + |x_2 - y_2| + |x_3 - y_3|)$$

$\forall\, t \in [0,1], \qquad x_1, x_2, x_{3,} y_1, y_2, y_{3,} \in R,$

$\sigma(t) \in (L^1[0,1]; [0,\infty))$

Then there exists a unique solution for the problem (1-5) for

$$r_1 < 1, \qquad r_1 = 2(1 + \phi^* + \psi^*)\sigma^* \left[\frac{1}{\Gamma(\alpha+\beta)}\right]$$

where

$$\sigma^* = \int_0^1 \sigma(t)dt$$

Proof. Define an operator A on X by

$$\begin{aligned}&A[x(t)] \\ &= \frac{1}{\Gamma(\alpha+\beta)} \\ &\times \int_0^t (t-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)d\tau \\ &- \frac{t^\beta}{\Gamma(\alpha+\beta)} \\ &\times \int_0^1 (1-\tau)^{\alpha+\beta-1} f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)d\tau\end{aligned}$$

Let us denote $sup_{0\leq t\leq 1}|f(t,0,0,0)| = f_0$,

and consider the sphere $B_r = \{x \in X: \|x\| \leq r\}$ where

$$r > \left(\frac{r_2}{1-r_1}\right), \qquad r_2 = \frac{2f_0}{\Gamma(\alpha+\beta)}$$

For each $t \in [0,1] and\ x \in B_r$, we have

$$\begin{aligned}&|A[x(t)]| \\ &\leq \frac{1}{\Gamma(\alpha+\beta)} \\ &\times \int_0^t (t-\tau)^{\alpha+\beta-1} \left|f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\right|d\tau \\ &+ \frac{t^\beta}{\Gamma(\alpha+\beta)} \\ &\times \int_0^1 (1-\tau)^{\alpha+\beta-1} \left|f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\right|d\tau \\ &\leq \frac{1}{\Gamma(\alpha+\beta)} \\ &\times \int_0^t (t-\tau)^{\alpha+\beta-1} \{\left|f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\right. \\ &\left. - f(\tau,0,0,0)\right| + |f(\tau,0,0,0)|\}d\tau + \frac{t^\beta}{\Gamma(\alpha+\beta)} \\ &\times \int_0^1 (1-\tau)^{\alpha+\beta-1} \{\left|f\big(\tau, x(\tau), \phi x(\tau), \psi x(\tau)\big)\right. \\ &\left. - f(\tau,0,0,0)\right| + |f(\tau,0,0,0)|\}d\tau \\ &\leq \frac{1}{\Gamma(\alpha+\beta)} \times \\ &\int_0^t (t-\tau)^{\alpha+\beta-1} \{\sigma(\tau)(|x(\tau)| + |\phi x| + |\psi x|) - f_0\}d\tau \\ &+ \frac{t^\beta}{\Gamma(\alpha+\beta)} \\ &\times \int_0^1 (1-\tau)^{\alpha+\beta-1} (\sigma(\tau)(|x| + |\phi x| + |\psi x|) + f_0)d\tau\end{aligned}$$

$$\leq \frac{(1+\phi^*+\psi^*)\|x\|}{\Gamma(\alpha+\beta)}\int_0^1 \sigma(\tau)d\tau$$

$$+\frac{f_0}{\Gamma(\alpha+\beta)}\int_0^t (t-\tau)^{\alpha+\beta-1}\,d\tau$$

$$+\frac{(1+\phi^*+\psi^*)\|x\|}{\Gamma(\alpha+\beta)}\int_0^1 \sigma(\tau)d\tau+\frac{f_0}{\Gamma(\alpha+\beta)}$$

$$\leq \frac{(1+\phi^*+\psi^*)\|x\|}{\Gamma(\alpha+\beta)}\sigma^*$$

$$+\frac{f_0}{\Gamma(\alpha+\beta)}\int_0^t (t-\tau)^{\alpha+\beta-1}\,d\tau$$

$$+\frac{(1+\phi^*+\psi^*)\|x\|\sigma^*}{\Gamma(\alpha+\beta)}+\frac{f_0}{\Gamma(\alpha+\beta)}$$

$$\leq \frac{2(1+\phi^*+\psi^*)\|x\|}{\Gamma(\alpha+\beta)}\sigma^*+\frac{2f_0}{\Gamma(\alpha+\beta)}$$

This indicates that $\|A[x(t)]\| \leq r$.

Therefore,$FA \subseteq B_r$. Now we show that A is a contraction mapping,

For $x, y \in B_r$, we have

$$|Ax(t)-Ay(t)|$$

$$\leq \frac{1}{\Gamma(\alpha+\beta)}\int_0^t (t-\tau)^{\alpha+\beta-1}\big|f\big(\tau,x(\tau),\phi x(\tau),\psi x(\tau)\big) - f\big(\tau,y(\tau),\phi y(\tau),\psi y(\tau)\big)\big|d\tau$$

$$+\frac{t^\beta}{\Gamma(\alpha+\beta)}\int_0^1 (t-\tau)^{\alpha+\beta-1}\big|f\big(\tau,x(\tau),\phi x(\tau),\psi x(\tau)\big) - f\big(\tau,y(\tau),\phi y(\tau),\psi y(\tau)\big)\big|d\tau$$

$$\leq \frac{1}{\Gamma(\alpha+\beta)}\int_0^t (t-\tau)^{\alpha+\beta-1}\sigma(\tau)\{|x(\tau)-y(\tau)|$$

$$+|\phi x(\tau)-\phi y(\tau)|+|\psi x(\tau)-\psi y(\tau)|\}d\tau$$

$$+\frac{t^\beta}{\Gamma(\alpha+\beta)}\int_0^1 (t-\tau)^{\alpha+\beta-1}\sigma(\tau)\{|x(\tau)-y(\tau)|$$

$$+|\phi x(\tau)-\phi y(\tau)|+|\psi x(\tau)-\psi y(\tau)|\}d\tau$$

$$\leq \frac{(1+\phi^*+\psi^*)\sigma^*\|x-y\|}{\Gamma(\alpha+\beta)}$$

$$+\frac{(1+\phi^*+\psi^*)\sigma^*\|x-y\|}{\Gamma(\alpha+\beta)}$$

$$\leq \frac{2(1+\phi^*+\psi^*)\sigma^*\|x-y\|}{\Gamma(\alpha+\beta)}$$

Since $r_1 < 1$, it follows that A is a contraction. This proves that the system (1-5) has a unique solution.

4. ILLUSTRATIVE EXAMPLES

From theorems 5 and 6, we have proved the existence and the uniqueness of the solutions to the initial value problem (1-5). Now in this section, we will present here a couple of examples that support our results.

Example1. Consider the initial value problem

$$D^{\frac{1}{4}}[D^{\frac{3}{4}}]x(t) = \frac{t^3}{400}\left[\frac{|x(t)e^{-t}|}{1+|x(t)|}\right] + \int_0^t \frac{(t+\tau)^3|x(\tau)|[\cos\tau+\sin\tau]}{400[1+|x(\tau)|]}\ldots (6)$$

under the initial conditions $x(0)=x(1)=0,\ t\in[0,1]$

Here $\alpha=\frac{1}{4}, \beta=\frac{3}{4}$ and

$$f(t,x,y,z) = \frac{t^3}{400}\left[\frac{|x(t)|e^{-t}}{1+|x(t)|}+\frac{|y(t)|\cos t}{1+|y(t)|}+\frac{|z(t)|\sin t}{1+|z(t)|}\right]$$

$$\lambda(t,s) = \delta(t,s) = \frac{(t+s)^3}{400}, \qquad \sigma(t)=\frac{t^3}{400}, \qquad k(t)=\frac{3t^3}{400}$$

From the definitions of ϕ^* and ψ^*, it can be easily verified that

$$\phi^*=\psi^*=\frac{15}{1600}, \qquad \sigma^*=\frac{1}{1600}$$

Hence by existence theorem 5, we conclude that the initial value problem (6) has at least one solution.

Example2. Consider the initial value problem

$$D^{\frac{1}{4}}\left(D^{\frac{3}{4}}\right)x(t) = \frac{t^2}{200}\left[\frac{1}{1+|x(t)|}+\frac{1}{100}\int_0^t t^4\tau^3 x(\tau)\,d\tau\right]$$

under the conditions $x(0)=x(1)=0,\ t\in[0,1]$

Here

$$\alpha = \frac{1}{4}, \qquad \beta = \frac{3}{4}$$

Also,

$$f(t,x,y,z) = \frac{t^2}{200}\left[\frac{1}{1+|x(t)|} + |y(t)| + |z(t)|\right]$$

$$\lambda(t,\tau) = \delta(t,\tau) = \frac{t^4\tau^3}{200}, \qquad \sigma(t) = \frac{t^2}{200}$$

Using the definitions of ϕ^*, ψ^* and σ^*, it is clear that

$$\phi^* = \psi^* = \frac{1}{800}, \qquad \sigma^* = \frac{1}{600}$$

Calculating the value of r_1, we have

$$r_1 = 2(1 + \phi^* + \psi^*)\sigma^*\left[\frac{1}{\Gamma(\alpha+\beta)}\right]$$

This gives $r_1 \approx 0.0033$. By theorem 6, we conclude that the initial value problem (7) has a unique solution.

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TOURISM ASPECTS OF NAGALAND: AN EMPIRICAL ANALYSIS

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Abstract: *Tourism in Nagaland was a late starter however the state has quite a lot in store for tourists to explore owning to the state's rich culture and assorted festivals and vicinity with interesting destination to visit. The measurement of tourist perception help identify the weakness and shortcoming aspects related to satisfaction, so the authorities may take necessary actions to improve tourist satisfaction based on the measurement. In this study, the authors tried to focus on the need for attaining tourist satisfaction and perception over different aspects of Nagaland tourism. Activities that attract tourists at the destination are obtained from the tourists during the study. The paper seek to contribute to the literature on the perception of tourists visiting Nagaland over different tourism aspects and examine whether there exist any significant difference on the basis of their demographical variables and the impact on the visitors' repeated visit to Nagaland during the study period. Primary data with a structured questionnaire is set to get the information and later the data was analysis through non-parametric test using Kruskal Wallis test because the data was not normally distributed. The analysis was also done using 27 statements on destination related as independent variables and four dependent variables i.e., type of tourist, age, gender, occupation. Even though the tourists are satisfied and like to behave positive, a considerable number of tourists are dissatisfied about certain areas at the destination.*

Keywords: *Nagaland tourism, tourism, tourist's perception, satisfaction*

1. INTRODUCTION

Tourism development is one of the key aspects that attract tourists travelling and visiting tourism destinations around the world (Hary Jocom, Dodi Setiawan, Indah Andesta, Aprilyana Kusuma Dewi, 2021). United Nation World Tourism Organisation (UNWTO) defines tourism as a social, cultural and economic phenomenon which entails the movement of people to countries or place outside their usual environment for personal or business purposes. It is defined as the act and process of spending time away from home in pursuit of relaxation, recreation, and pleasure, at the same time making use of the commercial setup of services (Walton, 2022). Over the decades, tourism has experienced continued growth and becoming one of the fastest-growing economic sectors across the world (UNWTO), its contribution to employment, revenue to government and generally economic development of the country. The most direct effects occur within the primary tourism sectors like accommodation, transportation, recreation, amusements and other related tourism services. The tourism sector can be considered as an economic cure for a state like Nagaland who has limited primary resources with only a small industrial base. Tourism in Nagaland has over the years, played a major role in boosting the economy and infrastructure of the state; created jobs, and led to overall growth and development (Mirror desk, 2019). It is a vibrant development instrument and an ideal economic alternative to develop the state since the area provides attractive destination, activities, and unique natural and pleasant climate, cultural and scenic resources. Nagaland state government has viewed the tourism and related service sector as one of the key areas which can positively contribute to the enhancement of the local economy (The Morung express, 2020). The benefits that brought about from the vibrant tourism activities can act as a catalyst to the economic development of the state, like any other state and countries which have adopted tourism as development tools.

Tourism aspects are defined as the attributes that satisfies the tourist and creates a revisit intention (Guzel, 2017). It represents a set of destination landscapes that describe the place as tourist destination, which affects the image of a destination. The aspects of tourism in Nagaland can also be précised as cultures, events, livelihood of people, hospitality, language, religion, festivals, heritage buildings and monuments, natural resources, infrastructures, hotels and restaurants, entertainment, shopping, etc that evokes interest, liking and desire for the tourists to visit. Many studies suggest that destination attractiveness depends on destination specific attributes and visitor satisfaction (Boit, 2014). Every destination has a unique attributes and attractions that lead to identify the area, potential for development to the large extent. Nagaland has its own attractions that continue to draw tourist from across the world. Tourism has been an important source for contributing economic development in the state for the past years. Dimapur and Kohima are two districts that are receiving over thousands of both foreign and domestic tourists annually.

2. LITERATURE REVIEW

There are several research studies that contribute to the tourism from different aspects. According to Philemon (2015) tourism industry is very much affected with the perception the tourists carry with

them about a destination. Likewise, Um and Crompton (1990) approaches towards tourism destination attributes are evaluated in terms of satisfying specific motives for travel pleasure. The destination selection process is greatly influenced by the tourists' motives, attitudes, and perceptions. Edward and George (2008) pointed out that attraction is the perceived ability of destination to deliver individual attractiveness and encourages tourists repeat visitation. They highlights the importance of specific destination attraction elements as core demands of the destination using qualitative stage involving an unstructured survey with tourists knowing the various relevant destination attraction and experience elements at Kerala tourist destination. Blázquez et al., (2012), applied Logistic Regression Analysis to establish a model of indicators of global quality of the destination advised to the companies that operate in the different tourist destinations when planning their activities that focus on better quality. Sukiman et al., (2013) study on tourist's satisfaction among international and domestic visitors in Pahang, Malaysia have used Holiday Satisfaction model (HOLSAT) to determine the gap between tourist's expectations and experiences based on 47 positive and negative attributes that were grouped into; accessibility, accommodation, tourist amenities, tourist activities, food/meal and tourism attractions. Similarly, Ortaleza and Mangali (2021), Jocom et al., (2021) also presented 5A's that attributes travel destination obtained from the tourists. Rajesh (2013) developed conceptual framework model on the basis of existing theoretical and empirical research in the field of destination marketing. The models include tourist perception, destination image, satisfaction, destination loyalty and the outcomes of the study have significant managerial implications for destination marketing managers. Ragavan et al., (2014) contributes to the literature on tourists' perception by evaluating the relationship between destination travel attributes and tourist satisfaction. To analyse the influence of travel attributes on satisfaction and the moderating effect of demographic factors, the researcher employed Partial Least Square (PLS), structural equation model (SEM) and the result shows that travel attributes had satisfactory predictive relevance and explained the changes in the variance of the endogenous variable tourist satisfaction. Similarly, Polas et al., (2021) also employed PLS to analyses the hypothesized that tourist perception mediates the relationships between tourist knowledge, tourist health risk, and destination personality with tourist hesitation at Bangladesh. Furthermore, Gnanapala (2015) calculate that the tourist satisfaction is depended on their perception related to the destination and associated factors in Sri Lanka and that there is a positive correlation and linear relationship between the tourists' perception and their satisfaction. Singh and Tiwari (2016) explore how destination attributes serve as incentives to promote an emerging destination, Udaipur, Rajasthan and based on the survey, the results indicate the services offered by the hotels/restaurants, and accessibility were the most important attribute for tourist satisfaction whereas, the recreational activities was the least important attribute by using one sample t-test analysis, regression analysis, multivariate analysis of variance (MANOVA). Haarhoff (2018) employed Chi-square tests to determine the difference in perception of first-time visitors compared to repeat visitors and argue that a good perception leads to a positive destination image, leads tourist satisfaction, which in turn results in destination loyalty. Mistry (2018) identified that tourists visiting Gujarat have certain expectations about various kinds of services at the destination which plays an important role towards satisfaction. The researcher then adopt descriptive research design to examine tourists' satisfaction in relation with the destination attributes importance using five-point Likert scale with the significant influence on satisfaction measured by 38 items with quantitative data and factor analysis technique. Kruskal-Wallis test is useful as a general nonparametric test for comparing more than two independent samples Ostertagová et al (2014). Nazakati et al (2013) study on Malaysia sport tourism have performed Kruskal-Wallis test for demographic components and logistic regression analysis and correlation analysis for studying relationship between the sport fan motivation component and travel constraints components. Konwar and Chakraborty (2013) highlight the views of local people with respect to geographical and structural factors associated with tourism in Majuli Island, on the basis of 50 statements an occupational based perception difference is tested with the help of Kruskal-Wallis test. It is found that the perceptions of locals towards the preconceived statements are satisfactory.

Some research paper on tourism in Nagaland from different perspective that centred around Problem and prospects, hidden resources of rural tourism, ethnic and cultural identity, unique dimension of cultural tourism, tourist satisfaction level with experiences have been reviewed. Jena (2000) paper on Problem and prospects of tourism industry in Nagaland address that it is important to investigate if there is any gap between the proposed goals and objectives set by Tourism Department and its actual performance and the fact that tourism has not only the economic dimension but social, political, cultural and environmental dimensions also. The study comprised 150 domestic tourists and 60 foreign tourists selected at random from three Government recognised tourist centres viz. Kohima, Dimapur, and Mokokchung. Statistical techniques like, Frequency distribution, percentage, mean,

range, standard deviation and regression analysis with the help of SPSS and Microsoft Excel Software. Ezung (2011) identify the potential of rural tourism in Nagaland and analysis that the state has abundant virgin forests, varieties of animals, rich culture and a rich set of organic agricultural products which are a boon for rural tourism. However, the inflow of tourists in the state is meagre due to many different reasons, that is, government restriction policies, insufficient infrastructure and a sense of insecurity. Keditsu (2017), employs a cultural studies approach using qualitative, exploratory and explanatory research at Kohima and hornbill festival. Sinha (2020) presented in what method Zutho, the traditional rice beer can be used as a trend of beer tourism or locally Zutho tourism and to evaluate the impact of Zutho tourism in improvising the overall tourism of Nagaland to bring economic growth in future and to utilize hornbill festival as a platform to promote it globally. Pongen (2021) applied ANOVA tool to analyse satisfaction of tourist visiting Hornbill festival with 5-point Likert scale. The researcher pointed that understanding Tourist satisfaction allows service providers to provide amenities and services that match the expectations of the tourist and ensure the satisfaction level with the experience they have perceived**.** However, Aomatsung (2021) in his paper mentioned that pandemic has deeply impacted on the tourism sectors and all tourism related activities. These are considered that tourism plays an important role in attracting tourist and the destination has all the important components to full fill the demands and needs of the tourists. Bhuiyan et al., (2021) argued that tourists are attracted to visit nature-based attractions to fulfil their different purposes and that it is necessary to measure tourist perception in an extensive context to identify the relevant attributes.

3. RESEARCH OBJECTIVES AND METHODOLOGY

The researchers have identified that previous studies focused only on tourism in Nagaland. However, the perception and satisfaction of the tourists are not found although many related papers have been studies apart for Nagaland. Few studies conducted in Nagaland are focused only on tourism related activities, culture and destinations. The research gap is that there is lack of studies on tourist's perception and their satisfaction on tourism in the state. These encourage the researcher to undertake the topic to focus on the need for attaining tourist satisfaction and perception over different aspects of Nagaland tourism. With this, the study tries to examine the inflow of the tourist and tourist perception over different tourism aspects with the help of the following objectives below. There are two major objectives of this research:

1. To study the perception of tourist in Nagaland over the different tourism aspects

2. To examine whether there exists any significant difference in perception of the tourist in Nagaland over the different tourism aspects on the basis of their demographical variables.

The study is empirical in nature. The study is carried out at different tourism destination under Dimapur and Kohima district of Nagaland. The sampling frame includes both Domestic and Foreign Tourists visiting various destinations in the sample region during the period of 2019-2021. The sampling method adopted for the data collection is random sampling method. The data from the respondents are collected randomly from various destinations under study area. The sample unit is determined using Cochran (1963) method. The sample size for the study is 384, which is divided into two groups of 288 domestic tourists and 96 foreign tourists. Therefore, for the present study 3:1 ratio of domestic tourist and foreign tourist in the sample size is maintained. In order to attain the objectives of the study, primary data is collected with the help of a well- structured questionnaire using a five-point Likert scale in order to derive the importance of different destination attributes. Some government and non-government agencies also store data that can be used for research purposes and has been retrieved from them. The data was not normally distributed therefore the study has applied non-parametric test. Statistical tools such as Kruskal Wallis test is used for analysing the data. Further simple statistical tools such as mean, percentage and compound annual growth rate (CAGR) are used for the study.

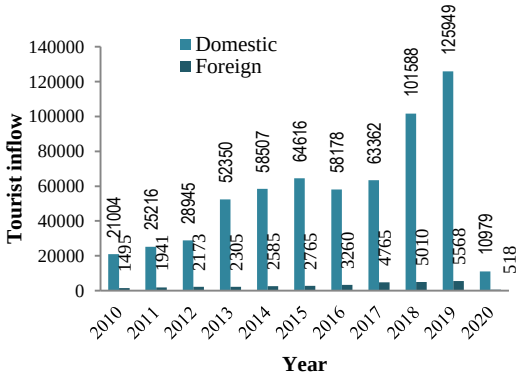
4. STATUS OF TOURIST INFLOW IN NAGALAND

The state has come a long way over the year and etched a name for itself in the world's tourist destination. The people, colourful culture and traditions, beautiful valleys and mountains, excellent handloom, handicrafts, arts, vibrant festivals, queer food, etc together make the places of tourist interest and scenic beauty and the tribal cultural activities, festivities, historical places attract tourist in Nagaland. With its moderate climate most of the year, scenic splendours and varied cultural attraction, the state is ideal for tourism as it has a number of sites that are worth visiting to get an insight into its rich art, culture and history. The hospitability of the people and their culture, tradition simply touch the heart of tourist.

Tourism in Nagaland at the early stage was not able to take off on its own due to the lack of infrastructure facilities and travel restrictions, insurgency and turbulent socio-political situation in the state for over two decades adversely affected in resulting to negligible tourism in the state. However, with the upliftment of protected area permit (PAP) the number of tourist has started to increase. According to the data, Nagaland received 11497 tourists in

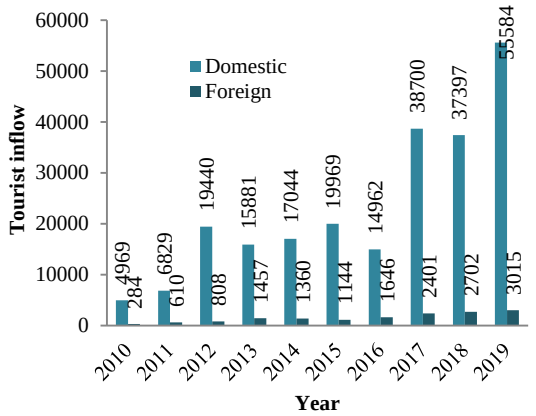
2020 while in 2019 the total number of tourists' inflow was 131517 which show a decline due to the Covid-19 pandemic.

Fig 1. Tourist arrivals in Nagaland



Source: Nagaland tourism 2021

Fig 2. Tourist arrivals during Hornbill Festival



Source: Nagaland tourism 2021

The Naga's history, culture, nature and the people are closely associated with tourism. It is a land of charm, diverse in landscape and culture and offers opportunities for a whole range of tourism activities, which to date has not been fully tapped. Tourism, however, was a late starter in Nagaland as it was only in 1981, that the Department of Tourism came to its own when it was bifurcated from the department of Information and Public Relation. The last two decade or so has not witnessed much development and at present the number of tourists coming to Nagaland is negligible. The number of tourist inflow to the state is expected to increase where most tourists come to witness the hornbill festival.

Nagaland state is characterized with unique features of distinct cultural heritage that distinguishes the state from the rest of the country. The state is also known as "Land of Festivals", and different festivities are a source for promotion of tourism. Most of the festivals in Nagaland revolve around agriculture since majority of the population in Nagaland depends on agriculture. To encourage inter-tribal interaction and to promote cultural heritage of Nagaland, the state government organises Hornbill festival every year to revive and protect the rich culture of Nagaland and display its extravaganza and traditions. And since then Hornbill festival has being one of the main sources of attraction to the tourists worldwide. Through hornbill festival it provides a platform for the locals to generate income through display and trade various traditional and cultural items giving opportunity to thousands of tourist every year who visits the state to witness and experience the essence of the festival.

5. RESULT AND DISCUSSION

The perception of tourists over different tourism aspects has been studied by measuring tourist satisfaction. From others research studies, it is understood that the satisfaction score on tourist perception over their visit to the destination has huge effect on the development to the tourism. In order to determine the statement of satisfaction, tourists were asked to respond to the statement by assigning score to them using five point Likert scale, ranging from 1 (highly dissatisfied) to 5 (highly satisfied) with the mean difference value, 3=neutral, less than 3=dissatisfied and more than 3= satisfied (A Singh and R Tiwari, 2016).

Table 1 Satisfaction level of the tourist (n=384)

Statements	HD%	D%	N%	S%	H%	Mean
Personal safety and security	9.63	14.32	25.52	29.94	20.57	3.38
Interesting culture and tradition	0	7.55	25.52	35.67	31.25	3.91
Cultural and historical attraction	5.20	13.80	23.43	26.30	31.25	3.65
Attractiveness of fairs and festivals	5.20	17.96	22.39	27.34	27.08	3.53
Scenic and natural environment	9.63	11.45	28.12	30.98	19.79	3.40
Opportunities for adventure	18.7	34.37	20.31	14.58	11.97	2.67
Varieties of tourism related-activities	17.96	32.29	20.83	17.18	11.71	2.72
Efficient local transportation services	17.70	29.16	28.90	15.36	8.85	2.68
Availability of quality accommodation	15.10	34.63	23.43	15.62	11.19	2.73
Availability of homestay and guesthouse	10.67	15.10	29.68	22.13	22.39	3.30
High quality restaurant	22.3	24.47	25	18.22	9.89	2.69
High quality hotels	12.23	19.53	29.42	20.83	17.96	3.13
Quality of local food	7.29	14.06	24.73	29.16	24.73	3.50
Local products as a souvenir	5.20	16.40	27.60	31.77	19.01	3.43
Tourists information center	25.52	26.30	22.91	15.36	9.89	2.58
Health care center	21.35	28.64	28.12	13.28	8.59	2.59
Money withdrawal facilities (ATM)	20.05	30.20	25	16.66	8.07	2.63
Banking facilities	21.61	29.42	22.39	17.18	9.37	2.63
Shopping facilities	10.67	20.57	34.37	20.83	13.54	3.06

Local tour guides/ tour operators	14.06	26.56	25.52	23.17	10.67	2.90
Availability of public toilets	27.08	27.60	24.47	14.32	6.51	2.46
Cleanliness	9.11	27.60	26.30	24.21	12.76	3.04
Language difficulties	20.31	38.28	20.05	14.32	7.031	2.49
Friendly people	11.71	15.10	25.26	25.52	22.39	3.32
Easily accessible of ILP/RAP	18.75	35.41	22.13	15.10	8.59	2.59
Availability of information sites like, brochure & website	4.88	9.22	5.76	3.93	2.23	2.99
Is it an expensive destination	15.88	27.08	25.26	19.27	12.5	2.85

Source: Own calculation using SPSS 16.0
HD= Highly dissatisfied, D=Dissatisfied, N=Neutral, S= satisfied, HS= Highly Satisfied

The above result shows that the tourists who visited Nagaland during the study were satisfied with 10 out of 27 statements. The study also found 15 statements dissatisfied and 2 neutral aspects of tourism. In the present study satisfied is defined as those statements with satisfaction scores are more than 3 mean values and with a t-value significant at the 0.5 level (Significant value $\leq$ .05). Out of 10 satisfied statement, the tourist were highly satisfied in interesting culture and tradition with the highest mean score **(**3.91) followed by second highest mean (3.65) cultural and historical attraction. Shopping facilities (3.06) and cleanliness (3.04) seems to be neutral in the aspect of tourism according to the tourists. The result also shows that availability of public toilets (2.46**),** language difficulties (2.49), tourists information center (2.58), health care center (2.59), easily accessible of ILP/RAP (2.59), banking facilities and money withdrawal facilities (ATM) (2.63), opportunities for adventure (2.67), efficient local transportation services (2.68) are some highly dissatisfied statements during their visit to Nagaland tourism destination.

The study further examined whether there exist any significant difference in perception of the tourist in Nagaland over the different tourism aspects on the basis of their demographical variables. Since assumption of normality could not be assumed, a Kruskal-Wallis test which is more suitable for non-parametric data has been conducted to find out whether there exist any significant difference in perception over different tourism aspects in Nagaland by the types of tourists. The result of p-value which falls above the scale level of neutral in 5-point likert scale, justifying that the respondents are more or less positive towards the tourism aspects carried in Nagaland with relation to destination and related activities.

Table 2: Kruskal-Wallis Test for tourist perception over different tourism aspects with grouping variable 'type of tourist' (n=348)

Parameters	Chi square(x^2)	df	p-value
Personal safety and security	16.794	1	.000*
Interesting culture and tradition	.231	1	.630
Cultural and historical attraction	7.783	1	.005*
Attractiveness of fair and festivals	1.698	1	.193
Scenic and natural environment	1.933	1	.164
Opportunities for adventure	20.974	1	.000*
Varieties of tourism related-activities	9.159	1	.002*
Efficient local transportation services	12.516	1	.000*
Availability of quality accommodation	71.035	1	.000*
Availability of homestay and guesthouse	29.556	1	.000*
High quality restaurant	2.560	1	.110
High quality hotels	14.123	1	.000*
Quality of local food	8.977	1	.003*
Local products as a Souvenir	.339	1	.560
Tourists information center	3.092	1	.079
Health care center	1.008	1	.315
Money withdrawal facilities ATM	18.495	1	.000*
Banking facilities	20.823	1	.000*
Shopping facilities	.956	1	.328
Local tour guides/tour operators	4.565	1	.033*
Availability of public toilets	.061	1	.805
Cleanliness	1.266	1	.261
Language difficulties	.044	1	.833
Friendly people	.691	1	.406
Easily accessible of ILP/RAP	15.425	1	.000*
Availability of information sites like, brochure & websites	3.322	1	.068
Is it an expensive destination	.548	1	.459

Source: Own calculation using SPSS 16.0
**Statistically Significant at 5% level of CL*

As shown in the above table type of tourists was significantly affected by personal safety and security, $x^2(1)=16.794$, $p<0.05(.000)$, Cultural and historical attraction, $x^2=7.783$, $p<0.05$, Opportunities for adventure $x^2=20.974$, $p<0.05$, Varieties of tourism related-activities $x^2=9.159$, $p<0.05$, Efficient local transportation services $x^2=12.516$, $p<0.05$, Availability of quality accommodation $x^2=71.035$, $p<0.05$, Availability of homestay and guesthouse $x^2=29.556$, $p<0.05$, High quality hotels $x^2=14.123$, $p<0.05$, Quality of local food $x^2=8.977$, $p<0.05$, Money withdrawal facilities (ATM) $x^2=18.495$,$p<0.05$, Banking facilities $x^2=20.823$, $p<0.05$, Local tour guides/ tour operators $x^2=4.565$, $p<0.05$, Easily accessible of ILP/RAP $x^2=15.425$, $p<0.05$. The result of Kruskal-Wallis test from the above table shows there is a difference between some mean score that are statistically significant for type of tourist and that not all the parameters are equal. It is seen that 13 out of 27 parameters are found that there is a significant difference by the type of tourists.

Table 3: Kruskal-Wallis Test for tourist perception over different tourism aspects with grouping variable 'age' (n=348)

Parameters	Chi square(x^2)	df	p-value
Personal safety and security	8.362	3	.039*
Interesting culture and tradition	6.524	3	.089
Cultural and historical attraction	2.273	3	.518
Attractiveness of fairs & festivals	12.157	3	.007*
Scenic and natural environment	1.877	3	.598
Opportunities for adventure	2.415	3	.491
Varieties of tourism related-activities	.394	3	.942
Efficient local transportation services	1.401	3	.705
Availability of quality accommodation	1.951	3	.583
Availability of homestay and guesthouse	1.190	3	.756
High quality restaurant	.396	3	.941
High quality hotels	10.259	3	.016*
Quality of local food	.792	3	.851
Local products as a Souvenir	14.334	3	.002*
Tourists information center	4.943	3	.176
Health care center	.389	3	.942
Money withdrawal facilities (ATM)	3.301	3	.348
Banking facilities	1.623	3	.654
Shopping facilities	.932	3	.818
Local tour guides/ tour operators	2.153	3	.541
Availability of public toilets	3.045	3	.385
Cleanliness	1.194	3	.755
Language difficulties	.247	3	.970
Friendly people	.976	3	.807
Easily accessible of ILP/RAP	.609	3	.894
Availability of information sites like, brochure & websites	5.845	3	.119
Is it an expensive destination	3.203	3	.361

Source: Own calculation using SPSS 16.0
**Statistically Significant at 5% level of CL*

In the table 3, age was significantly affected by Personal safety and security $x^2(3) = 8.362$, $p<0.05(.039)$, Attractiveness of fairs & festivals $x^2=12.157$, $p<0.05$, High quality hotels $x^2=10.259$, $p<0.05$, Local products as a Souvenir $x^2=14.334$, $p<0.05$. In the case of age 4 parameters are found that there is a significant difference on tourist perception over different tourism related activities and that not all the parameters are equal.

Table 4: Kruskal-Wallis Test for tourist perception over different tourism aspects with grouping variable 'gender' (n=348)

Parameters	Chi square	df	p-value
Personal safety and security	.597	1	.440
Interesting culture and tradition	.095	1	.757
Cultural and historical attraction	.007	1	.933
Attractiveness of fairs & festivals	1.086	1	.297
Scenic and natural environment	2.785	1	.095**
Opportunities for adventure	3.432	1	.064**
Varieties of tourism related-activities	1.716	1	.190
Efficient local transportation services	.002	1	.966
Availability of quality accommodation	.369	1	.543
Availability of homestay and guesthouse	.186	1	.666
High quality restaurant	1.159	1	.282
High quality hotels	.081	1	.775
Quality of local food	.261	1	.609
Local products as a Souvenir	1.281	1	.258
Tourists information center	.791	1	.374
Health care center	.562	1	.453
Money withdrawal facilities ATM	.472	1	.492
Banking facilities	.134	1	.714
Shopping facilities	1.512	1	.219
Local tour guides/ tour operators	.444	1	.505
Availability of public toilets	.425	1	.515
Cleanliness	.311	1	.577
Language difficulties	.339	1	.561
Friendly people	.744	1	.388
Easily accessible of ILP/RAP	3.479	1	.062**
Availability of information sites like, brochure & websites	.522	1	.470
Is it an expensive destination	.442	1	.506

Source: Own calculation using SPSS
*** Statistically significant at 10% level of CL*

In table 4, gender was significantly affected by scenic and natural environment x^2 (1) = 2.785, $p<0.1(.095)$, opportunities for adventure $x^2=3.432$, $p<0.1(.064)$, easily accessible of ILP/RAP $x^2=3.479$, $p<0.1(.062)$ which are measured statistically significant of p value 0.1. Three parameters from the variable gender are seen to be significantly different on tourist perception over different tourism related activities and that not all the parameters are equal.

Table 5: Kruskal-Wallis Test for tourist perception over different tourism aspects with grouping variable 'occupation' (n=348)

Parameters	Chi square	df	p-value
Personal safety and security	2.267	4	.687
Interesting culture and tradition	1.478	4	.830
Cultural and historical attraction	4.683	4	.321
Attractiveness of fairs & festivals	10.862	4	.028*
Scenic and natural environment	.784	4	.941
Opportunities for adventure	4.010	4	.405
Varieties of tourism related-activities	.889	4	.926
Efficient local transportation services	.639	4	.959
Availability of quality accommodation	11.182	4	.025*
Homestay & guesthouse availability	4.807	4	.308
High quality restaurant	5.272	4	.261
High quality hotels	3.525	4	.474
Quality of local food	1.130	4	.889
Local products as a Souvenir	4.937	4	.294
Tourists information center	5.343	4	.254
Health care center	4.698	4	.320

Money withdrawal facilities ATM	3.135	4	.536
Banking facilities	2.603	4	.626
Shopping facilities	1.982	4	.739
Local tour guides/tour operators	1.596	4	.809
Availability of public toilets	3.039	4	.551
Cleanliness	1.410	4	.843
Language difficulties	4.495	4	.343
Friendly people	3.160	4	.531
Easily accessible of ILP/RAP	4.593	4	.332
Availability of information sites like, brochure & websites	4.879	4	.300
Is it an expensive destination	1.324	4	.857

Source: Own calculation using SPSS 16.0
**Statistically Significant at 5% level of CL*

In the table 5, occupation was significantly affected by Attractiveness of fairs & festivals $x^2(4) = 10.862$, $p<0.05=.028$, Availability of quality accommodation $x^2=11.182$, $p<0.05$. While analysing the grouping variable occupation with the help of Kruskal Wallis statistic it has been found that out of 27 parameters only 2 parameters shows there is a significant difference on tourist perception over tourism related activities and that not all the parameters are equal.

6. CONCLUSION

The study focuses on the inflow of tourist and their perception towards different tourism aspect and their satisfaction during their visit to the destination. Even though the tourists are satisfied and like to behave positive, a considerable number of tourists are dissatisfied about certain areas of the destination such as availability of public toilets, language difficulties, tourist's information center, health care center, easily accessible of ILP/RAP, banking facilities and money withdrawal facilities (ATM), opportunities for adventure and efficient local transportation services. Kruskal Wallis test was used to examine the tourist perception by using and measuring 27 destination related independent variables and four dependent variables i.e., type of tourist, age, gender, occupation. According to the analysis, it is seen that type of tourist, age, occupation variables are significant which means that the dependent factors are influencing the positive perception of the tourist while gender does not have a significant difference with the parameters.

Tourism was a late starter in Nagaland and being located at the borderland area, posturing a huge opportunity in the field of tourism among other spectrum. Simultaneously it also requires strategic marketing plan for developing tourism with target customers, their needs and wants such as tourist spots infrastructure. However, the tourism study shows that Nagaland is still nagging behind. Tourism adds to the local economy in a variety of ways, through hotels and restaurant, fare and freight paid on transportation and conveyance, attraction of foreign capital in infrastructure development, asset formation in tourist spots, creation of additional jobs in such areas as public services and infrastructure renewal. However, in the case of Nagaland, tourism oriented business is area specific and therefore there is an unequal opportunity unless spots are identified as tourist spots by the government and initiatives taken by the government to develop the area so as to attract tourist. The rich heritage which the people rightly boast about have been attracting tourist from different walks of life, yet the performance has not been up to the mark.

There is still a lot of gap to be filled in enhancing the quality of experience that could be provided to the tourists which would result in a huge return. The performance of the sector is far from satisfactory as it still lacks basic infrastructure such as poor road condition, lack of sanitation facilities, lack of public transport, banking facilities, few good quality hotels, restaurants, etc. The state is lacking behind functioning of social media, websites, tourism information centres. The maintenance on department website is still far behind. As a matter of fact, there are less influential private agencies to take care of tourism industry in the state. The prospect for tourist to flourish in Nagaland could be realized if the required improvements are made. There is a possibility of the region's economy to be generated through tourism. Nagaland being rich in tribal cultural festivities with varieties of traditional display of traditional attire, Ethnic foods, handicrafts, handloom, weaving, that attract the tourist could be enhanced through exposure by the media. Transportation being the key element for the mobility of the people should be well maintained, ensuring cleanliness and comfortably. Availability of tourist's village escorted with well-educated tourist guide would enhance the experience of the visitors which will sequentially attract more tourists. The tourism industry could be the revenue hub of the state since the sector has the opportunity to employ a large portion of the population in the various economic activities with abundant natural resources revolving around the state. Taking all these into consideration, tourism industry to flourish in the state could be realized. The future of tourism in Nagaland is certainly bright. Development of quality infrastructure will be the key to connecting the state full tourism potential. Tourism is the most productive sector for the beautiful state like Nagaland which can contribute to the state economy.

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WHAT REALLY MEANS TRANSDISCIPLINARITY FOR A MODERN NATIONAL ACADEMY? ACADEMIC EVOLUTION OR INVOLUTION BASED ON SOME RELEVANT STATISTICS AND INFORMATION FROM ROMANIA?

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Abstract. *National Academy of Romania and the French source of its model are confronted in the first part of this paper, in a statistical manner, starting with the necessity of transdisciplinarity for this major cultural, educational and research institution. After a brief introduction underlying the academic educational value of transdisciplinarity and its impact on modern scientific research, this paper details some major aspects connected to the Romanian Academy. Unfortunately, the Romanian Academy remains a copy damaged over time or even unsuccessful in the last eight decades, and no longer has anything in common with the quality, morality and integrity of its model, the French Academy. The contagion suffered from the contact with the Romanian society and the rest of the deeply corrupt and immoral national institutions affected the Romanian Academy with greater intensity and severity and had a much greater impact in relation to that found on all other state institutions. Some final remarks are important for a better understanding of a national academy for academic education and also for modern research.*

Keywords: *national academy, source of model, transdisciplinarity, evolution, involution, statistics, confrontations, inter-, multi-, and cross-disciplinarity.*

1. INTRODUCTION

Transdisciplinarity becomes by simplification and for the most part a simple cultivated conversation, critical and sprinkled with a lot of inherent misunderstandings, which impose revisions and even reformulations, keeping the quality of transmitter of information, about efficient and even optimal forms of collaboration, but also about rules for solving the increasingly complex problems of reality (Serres, 1991) [1].

The integral and structured approach of the future of transdisciplinarity in the fields of academic knowledge and scientific research reveals, in Basarab Nicolescu's opinion, a common bond in the *sacred and sacredness* (Caciuc, 2000, p. 313) [2] and leads to a *fusion of the subject with the object* of knowledge, which generates both an extended acuity and a much improved deductive-anticipatory capacity. A future subject to increasingly accelerated changes in the type of thinking, knowledge and scientific investigation, capable in real time of discovering trends, structures, formal or informal perspectives, continuously placed in an interactive relationship with the stages of knowledge mapping, focused on instability or transformation, but also on symbiosis or regeneration, this type of future will intensively develop any transdisciplinary approach. This is the evolution expected in this 21st century and its accelerated dynamics will place transdisciplinarity beyond the values and aspirations of each individual discipline, towards a true knowledge of the human condition, coherently structured through practical actions and through the consequences of acts of knowledge and investigation.

Beliefs, fine arts, architecture, and music will permanently restructure transdisciplinarity. As an example of the diversity of the future, even multiplied faiths will coexist more intensely, from cold faith or offensive atheism to fundamental faith or metaphysical thinking, from weak faith or focused on piety, tolerance and respect, to existential faith or the search for harmony in human life, from faith as occultism to theophanic faith in a self-creative universe, from theosophical faith or focused on rational knowledge of reality, to critical or non-reductive faith, etc. (Caciuc, 2000, p. 314-316) [2]

The relationship between the mind and the world will constantly change, having as important effects on transdisciplinarity in the immediate future as in the medium or long term.

The reality of the world is also produced and structured as an interpretation, which over time forms conflicting traditions of thought, which can give rise to "*returns*" (Vattimo, 1983) [3] or transformation processes through "*unlimited semiosis*" (Eco, 2007) [4].

Among the absolutely necessary requirements for the new transdisciplinarity of the future, the following can be distinguished: i) reducing the complexity of reality through knowledge and scientific research; ii) obtaining effectiveness through or based on contextualization; iii) achieving integration through open confrontations; iv) the development of reflexivity through recurrence (Hirsch Hadron, *et al*, 2008) [5].

The transdisciplinarity of the future will seek more intensively the integration of form with content, this separation being a deeply conventional one, specific to discursive analysis and nothing more. The conflict of open transdisciplinarity questions can and will certainly give way to creating tension in the medium and long term.

Transdisciplinarity will not be practically identical to mediation, but rather will remain a permanent "*model of the fusion of horizons*" (Gadamer, 1975) [6].

The clarification of such a fusion of horizons will only be possible with the help of a dialogue, a real one that will start from the preserved traditions of existing knowledge, against the background of a perpetual confrontation between the past, present and aspirations for the future... (Caciuc, 2010, p. 327) [2].

The transdisciplinarity of the future will become by simplification and for the most part a simple cultivated conversation, critical and sprinkled with inherent misunderstandings, which will impose revisions and even reformulations, keeping the quality of transmitter of information, about efficient and even optimal forms of collaboration, but also about rules for solving the increasingly complex problems of reality (Serres, 1991) [1].

Naturally, for us Romanians, the closest guide on the map of transdisciplinarity was, is and will remain for a long time also Basarab Nicolescu:

"*Transdisciplinarity leads to open attitude towards myths and religions and towards those who respect them in a transdisciplinary spirit [...] there being no privileged culture in relation to the others. The transdisciplinary approach is itself transcultural*." (Nicolescu, 1996) [7].

2. SOME RELEVANT STATISTICS AND INFORMATION ABOUT THE ROMANIAN ACADEMY

This introspection into the importance, and role of statistical restitution of the Romanian Academy, especially of the evolution or involution over time, from the moment of its appearance until now, should reveal or not a natural extension of its real model. The French Academy, the profound model of the Romanian Academy, had always and still has a stable, constant composition of only 40 members. This issue is a true landmark of French culture, from the year 1635 when the French Academy was practically founded by Cardinal Richelieu. If one of the French Academy's members does not die or is not dismissed for a serious act as an illegal or immoral deed, another Frenchman has no way of ending up among the "immortals", as all academics in France are known. But this limit is also relativized, there are always vacancies within this venerable academy. Currently, the number of vacant places is 5, and thus the actual average occupancy is only 87.5%. Placed or located 2,300 kilometres away, in Bucharest, a well-known city especially in the interbellum period as "*Little Paris"*, the Romanian Academy, which only completed 155 years of existence in 2021, could have, according to the law and its statute, a number of 181 members. Currently, the much younger and more extensive Romanian Academy has 90.6% occupancy average rate (164 members).

*Source: Communication supported by the author at SRS - "Octav Onicescu" Romanian scientific seminar on statistics on 28.04.2022, Statistical tools for measuring transdisciplinarity, a tribute to the mathematician Dan Barbilian, **alias** the poet Ion Barbu.*

Fig.1: Side-by-side images of the original French Academy model (right) and the Romanian Academy copy (left) (35 versus 164)

Thus, that things not only seem, but are actually more complicated than ever and everywhere, in Romania its national academy, currently has five other "so-called academies" and this at a time when its population and its cultural traditions have barely represented less than a quarter of those of France. In detail, here are the following five political academies as really clones:

i) Academy of Technical Sciences (ATS);

ii) Academy of Medical Sciences (AMS);

iii) Academy of Agricultural and Forestry Sciences (AAFS);

iv) Romanian Academy of Scientists (RAS);

v) Academy of National Security Sciences (ANSS).

Each of these clones of national academy has hundreds of full and corresponding members, most of them benefiting from allowances and other substantial advantages (Table no. 1):

Table no. 1: Estimated statistics* from the clones of national academy's links

Academy's abbreviation	Data access link	(Re)establishment Year	Branches	Current number of members	
				Total*	of which: titulars
ATS	https://astr.ro/	1997	6	250	150
AMS	https://www.adsm.ro	2004	6	230	190
AAFS	http://www.asas.ro	1962	6	140	80
RAS	https://www.aosr.ro	1996	9	230	132
ANSS	https://www.assn.ro	2012	1	20	16
TOTAL			28	870	568

Note: Data were taken by the author from the most recent tables presented on the detailed links of the abreviated institutions (in total they were slightly rounded or approximated to the first level – using tens)*

In the end, it seems that either someone was missing from the lists or there were not enough secondary academies, in 2015 another one appeared or, more correctly, one more was established by law 129/2015, one which is as unuseful as all the others based on all the final results in education and scientific research. It is about the Romanian Academy of Legal Sciences (RALS).

How could all these simple statistics be rationally explained?

Or even more clearly, what moral or deontological coverage do these numbers have, when all these clones of a national academy do not materialize into something evolutive and useful, even when they seem to have a real cultural impact?

Could anyone coherently justify such a thing as evolutive or more properly as unevolutive trend?

Whoever she or he is and however well she or he may be guided by the most honourable intentions, she or he will still remain circumspect, and this is especially because academic life does not seem to be important to anyone in Romania, and its real impact on middle school, high school and academic education, but above all, on scientific research is almost *nil*, in the context of an increasingly worrying functional illiteracy and minor results and contributions of national research in the Romanian GDP.

While the number of these academies increases, renamed, re-established or reoccupied, with newer or older names, most of their titular members are looking for any kind of allowances or positions, even for special or additional pensions, out of imaginary needs or out of conceits lacking real coverage and pragmatism. Finally, in Romania, the share of innovative enterprises in the total number of companies is continuously decreasing and that of auxiliary academies is constantly increasing with no real result, except the sum allocated from the state budget to exist. In the more recent period, between 2018 and 2020, compared to 2016-2018, the share of economic agents as real innovators decreased by 3.9%, and the number of secondary (auxiliary) academies practically increased to 6 (after 2015), respectively by 20%.

3. SOME HISTORICAL INFORMATION

Ioan Maiorescu, Titu Maiorescu's father, was practically the one who first proposed, in 1860, "*an academic society that would concentrate the activity of Romanian scholars... for the culture of the language, for the writing of national history*". The first institutional form was named the *Romanian Academic Society* and was established on April 1, 1866. On March 30, 1879, by a special law, the *Romanian Academic Society* became a national institution, under the name of the *Romanian Academy*. (Berindei, 2006) [8]

From the very beginning, the role of this institution should have been that of a forum for morality and scientific independence. The number of founding members of the Romanian Academic Society and later that of the Romanian Academy, but only for a short period of time, followed the initial French model, being approximately 25 in total. However, it is also true that the first president of the *Romanian Academic Society* was none other than Ion Heliade Rădulescu, who fulfilled this position with the utmost rigour until August 1, 1870. Later, that is, until the end of the millennium, the same Romanian Academy brought together almost 134 years, almost 1500 members, of which: 980 Romanians (from the 25 founders to 375 full members, plus 178 honorary members, but also 361 corresponding members, as well as 41 members elected post-mortem) and a number of 514 foreign members (404 honorary or titular members, 109 correspondents and one elected posthumously). Among the latter, there were representatives of large European nations such as France, with a number of 163 members (31.7%), followed by Germany, with 60 members (11.7%), then Italy, with 48 members (9.3%), but also the USA with 39 (7.6%) and England with 22, (4.3%) etc. (Rusu, 1999; 2010) [9,10].

The institution, newly founded after 1879, was initially a national encyclopedic society, becoming essential for Romanian spirituality, through its cultured people from the country and abroad. His concerns extended to the arts, letters and science. Since then, the Romanian Academy had to function as a national forum of recognized personalities of

scientific, literary and artistic research, and the academicians had the obligation to be "*moral and independent persons in their works of any nature*".

From June 9, 1948, by Decree no. 76, the Romanian Academy was abolished, establishing instead a completely different institution, politically titled the Academy of the Romanian People's Republic. This institution, like all communist ones of Soviet origin, was placed under proletarian and implicitly harmful influences. As a necessary parenthesis, it should be recalled that the first Russian academy was founded on January 22, 1724, by Dimitrie Cantemir with the support of his good friend, Gottfried Wilhelm von Leibniz, and the result remained known as the Petersburg Academy of Sciences which became, finally, in the Russian Academy of Sciences. But this honest and well-intentioned achievement of one of the great Romanian intellectuals had nothing in common with what turned out to be the popular communist academies, mostly of the Soviet type, permanently under the harmful influence of Russia and oriented in the strictly political way towards communism, anti-traditional and anti-national in relation to the culture of the state where an *Academy of a People's Republic* was being re-established...

Certainly, it was not about a transformation of the Romanian Academy, but the provisions of the decree given between 1948 and 1989, during the communist dictatorship, practically abolished the old institution, there being no clause to ensure continuity between the two. The new list of members of the *Academy of the Romanian People's Republic* included almost entirely new names of communist political personalities, not at all cultural or scientific memebers, with certainty proven by censorship and subsequent purges as anti-Romanian, from Mihai Roller to Simion Iagnov, from Nicolae Profiri, at Ștefan - Marius Milcu, etc. In a few years, the institution turned into the *Academy of the Socialist Republic of Romania*, and the awarding of the title of academician became only a political act, with similar echoes even today, the criterion of scientific erudition and intellectual morality being replaced by those of "*healthy origins*" and "*merits of the unique party*"...

The initial prestige of the Romanian Academy did suffer too much anyway, after, out of purely political interests, this institution then called the *Academy of the Romanian Socialist Republic*, received as new members two illiterate people, in the persons of the spouses Elena and Nicolae Ceausescu. After 1990, when democracy reappeared in Romania, the Academy of the Socialist Republic of Romania formally resumed its old name *Romanian Academy* [11, 12], without succeeding in becoming a real democratic institution, not even after more than three decades…

After the institutional Sovietization of the Romanian Academy, one began to feel the almost total lack of humility of those moral leaders, capable of resigning or asking for forgiveness in public, whenever it was necessary or out of respect for ordinary people and their communities. Among the members of such an institution, neither the truth nor morals or professional ethics were valued anymore, even among the devoted and learned, previously able to recognize their serious errors committed more or less accidentally. The loss of academic virtue was increasingly clear to the extent that their words, acts and deeds were in complete contradiction with each other, but also with the initial institutional purpose of the Romanian Academy, all being placed under the impact of political extremism and dictatorships.

To show, however, that there was still some discernment of the system in the last thirty years, noting at the same time a "demonetization through academic excess", but also from the exacerbated pride of the new members, it was finally established by law that only the members The *Romanian Academy* is officially given the right to bear the title of "*academician*". All these trends belong to the last three decades, in a context in which it was not considered necessary to reduce everything to a single national academy, but it had already multiplied six times, generating a veritable inflation of academics, and from the French model with 40 academic chairs of which only around 35 were usually occupied, in Romania, it was established that a number of over 1000 titular and corresponding members, all academics, These aspects could be sufficient to describe the academic degradation... At the same time, although the national model was clearly based on the French model, the post-war copy and all that followed became a Soviet one: "*because only in the Soviet model is scientific research done inside the Academy*" (Mircea Miclea, former Minister of Education, *PressOne*).

Finally, perhaps it would be necessary to officially recognize that there were some unpleasant events and traditions in the first years and some even disastrous ones in the last years of the existence of the Romanian Academy. Events of this kind were admittedly fewer in the early years, but significantly more and more serious in the last ones. Thus, after its establishment, Andrei Vizanti, elected as a corresponding member in 1882, was removed after 1903, as a result of the fact that he left the country to avoid being punished for embezzlement of public funds. Another famous example in its essence is constituted by the controversial academic, Alexe Procopovici, whom Eugen Lovinescu said was "*the man who wrote nothing*".

But what happened during the communist period remains unmatched by the institutional extremism,

even by the total abdication of all minor institutional principles, as well as by the lack of a minimum of morality. Thus, the maximum academic degradation has its beginning as an intense and unfinished process in 1974, when Elena Ceaușescu, fundamentally illiterate, was elected a titular member, and 11 years later, in 1985, Nicolae Ceaușescu, a notorious illiterate himself, became both a titular member and honorary president of the Academy of the Socialist Republic of Romania. After 1990, there should not have been any of the previous members in the new Romanian Academy, none of those who participated and voted for these people, but there are still academics today, who consider themselves completely innocent and moral among them...

Elena and Nicolae Ceausescus, both ignorant and even illiterate, became, in a purely political manner, academics, but they would not have succeeded without the clear support of the other supposed academics, all of whom lack the minimum decency or a minimum of common sense or morality. Even if these two illiterate people, who made up the dictatorial couple, were first executed, and then excluded post-mortem from this completely fake academy, especially after December 26, 1989, there was no general resignation, nor was it requested, or at least an individual act of regret or remorse or a desire to repent in relation to real academic meritocracy, of any voter of their quality, completely falsified by academics. The same happened with other politicians of the time, like Manea Mănescu, who became a full member of the Romanian Academy, as early as 1974, and who was excluded only on February 2, 1990, or like Suzana Gâdea, who was stripped of her title due to some criminal convictions. The real Romanian Academy today is deeply compromised in relation to its historical purpose and completely dishonoured in its moral essence, by all those who voted then, without resigning instantly or later, after natural remorse for truly virtuous people...

Beyond the lack of respect for traditions, for the efforts of a people mocked and implied for history and the past, the lack of obvious morality, the absence of minimal decency and ethics, the fraud of some assets belonging to the academy (the examples regarding the fraud of lands of the Romanian Academy by leasing harmful, by selling them below the price or simply giving them away, after which unimaginable processes took place with their final verdict), as well as the fraud of public money, some of which disappeared under the signature of contemporary academics (the example of the 2.8 million lei, representing allowances of some deceased academics, money falsely paid to others, during nine years, etc.), evidence appears more and more frequently that underlines a serious incompetence of some of the members of the current Romanian Academy (the most eloquent example being the relatively recent one of August 27, 2020, when the Romanian Academy issued a statement in which conspiracy theories about e 5G and a gross fake about WHO).

The time has probably come or will come as soon as possible and the doors of the Romanian Academy, an institution too often politically rechristened, the beneficiary of many immoral solutions, focused on a scientific knowledge that is increasingly out of date or even limited, will close of its own accord in relation to the current international status, as well as on an increasingly restricted recognition, if not almost lost as a moral impact, isolated in the rigid universe of rival uni-disciplinarities, with perverted deontology, unadapted to many of the international projects and teams, and in several fields where it had historical traditions even deprofessionalized. If these gates are ever to be reopened, the act will probably be done gradually, after a large part of these false generations from which these 1,000 academicians have sprung have naturally passed away, others in trials to avoid deprivation of freedom, and the completely immoral scientifically under the pressure and fear of the material consequences of an eternally practised plagiarism. Maybe some future Romanian academics will be rediscovered, inside but also outside the traditional Romanian space, who will be able to close the gates of false knowledge, excessively politicized, immoral, as well as that lacking good expertise or real skills ...

4. SOME FINAL REMARKS

To have a more comprehensive view of the future of the Romanian Academy, and of the cohesion or unity as a structured academic universe of the spirit of a nation, initially multiplied through inter-, cross-, and multidisciplinarity one needs many more theoretical types of research and practical investigations, based on statistics and information.

However, even this paper can be a good example, showing that the academic universe must be a transdisciplinary one, to be evolutive, and especially useful for a nation, for its education and scientific research. Any national academy requires deep moral foundations and overall evolution analysis, especially in the form of more clearly defined statistical terms not only in mathematical language but also in historical information.

Because nothing can be more disastrous for any community or country, than the proliferation of a completely immoral type of intellectual, as an old Romanian proverb bitterly states, because "*morality is identical for the soul of a people, with health for the human body*!" Another proverb, a German one this time, always keeps a well-deserved place for new generations of researchers and intellectuals who are truly moral and willing to contribute and replace the elderly in academic and scientific communities, in human societies that behave stably,

in orderly and truly wise: "*Only three glasses are always needed: the first for health and good mood, the second for creation and wisdom, and the third for sleep and ... rest*." [13]

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ROLE OF TRANSITION METAL COMPLEXES IN ANTI CANCER BATTLE

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Abstract. *Cancer is a severe health issue that affects people all over the world. The wailing of most cancers affected patients is the primary motivation behind the development of new therapeutic agents and remedies of cancers. Cisplatin, a platinum based anticancer agent, is one of the most potential and commonly used medicines for the treatment of many solid cancers. However, the severe toxic concomitant effects exerted by widely used platinum based complexes have encouraged researchers to apply molecular modeling and engineering to synthesize novel transition metal-based anti-tumor drugs with lowered toxicity. The transition metal complexes that are promising anticancer agents are discussed in depth in this article, with a focus on cisplatin and associated compounds. Detailed metalated DNA structures with mechanisms of action involving intercalation are presented and discussed in light of antitumor activities.*

Keywords: *DNA binding, cancer, chemotherapy, transition metals, platinum, ruthenium*

1.INTRODUCTION

Metals and their salts have been employed for therapeutic purposes since the ancient days. Metals in medicine comprise the administration of metal ions into a living organism either by fortuitously or by intention. Metals, on the other hand, are essential biological elements that nature has chosen to carry out many essential biochemical activities in living organisms [1]. The distinctive features of transition metal ions have been exploited to design new medications in the field of inorganic medicinal chemistry.

Cisplatin with no organic units is one of the most widely used chemotherapeutic agent in clinical applications, began the documented history of transition metal-based anticancer drugs [2]. However, *cisplatin* and its analogs can binds with a large range of biomolecules other than their primary biological target: DNA.

Therefore despite of its clinical success there are various toxic side effects associated with *cisplatin*, such as nausea, nephrotoxicity and neurotoxicity [3]. Since then, an increasing number of platinum based metallo-drugs were synthesized in an endeavor to mitigate those shortcomings, albeit
many complexes have comparable mode of action and resistance indices [4].

Not only platinum, many other transition metal complexes have received considerable interest as a replacement of *cisplatin*, due to their propitious cytotoxic and promising anticancer profiles. In this regard Pd, Ru, Rh, Ir, Au, Cu and Os complexes are the potential members in cancer chemotherapy [5-6].
The activities of transition metals in cancer therapy and recent breakthroughs, as well as innovative strategies for building novel metal complexes as anti-cancer medications, are the topic of this article.

2. TRANSITION METAL BASED CHEMO-THERAPEUTIC ANTICANCER AGENTS

2.1 Platinum

The discovery of *cisplatin* by Barnett Rosenberg and colleagues in late 1960 while exploring the effect of electric fields on bacterial cell division was a watershed moment in the history of inorganic complex drug development in cancer treatments. As a result of *cisplatin's* clinical success, a surge of interest in platinum-based prospective anticancer medicines has emerged, with zillions of analogues being produced and screened for properties that would enhance its therapeutic profile.

Only a few compounds have made it to clinical trials, and more than half of them have been rejected. *Cisplatin*, *carboplatin*, and *oxaliplatin* are the three platinum-based anticancer medicines that have been approved for clinical usage worldwide to date. *Nedaplatin* (Japan), *miriplatin* (Japan), *lobaplatin* (China), and *heptaplatin* (Korea) are four more platinum-containing medicines that have been approved for use in certain countries [7].

Some platinum complexes are still under clinical trials, including those developed for oral administration, like Pt (IV) anticancer agents with the hope that such complexes will be able to meet the demand for novel antitumor drugs.

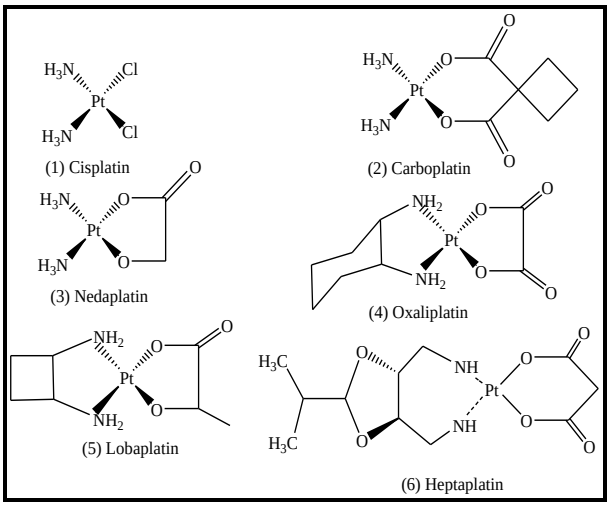

Fig. 1: Chemical structures of some selected platinum drugs

2.2 The proposed mechanism of action

The generalized mechanism of action consists of four discrete chronological processes: (i) cellular uptake, (ii) aquation/activation, (iii) DNA platination, and (iv) cellular processing of drug inducing to apoptosis. *Cisplatin* is given to patients intravenously as a sterile salt solution, and the medicine is carried throughout the body by the bloodstream.

The high chloride concentration in blood serum (≈100 mM) suppresses the aquation of *cisplatin* i.e. substitution of chloride ions by water molecules, leaving *cisplatin* unchanged and neutral. Therefore, *cisplatin* arrives at the membrane of cancer cells mainly as a neutral molecule. The richest protein in human blood plasma, serum albumin, can bind strongly to *cisplatin*, causing a large amount of the drug to be deactivated. In fact 65 to 95% of *cisplatin* can bind with plasma protein via sulphur from the thiol groups of amino acids like cysteine [8].

The remaining drug, *cisplatin*, enters cells either via passive diffusion through the plasma membrane or active transport arbitrated by membrane proteins.

Lower intracellular chloride ion concentration (2-30 mM) promotes the synthesis of aqua species from *cisplatin* by replacing one or both chloride leaving group(s) with a water molecule(s) inside the cell.

As a result, cationic aquatic products such as *cis*-$[Pt(H_2O)Cl(NH_3)_2]^+$ and *cis*-$[Pt(H_2O)_2(NH_3)_2]^{2+}$ are formed. The first aquation process, which produces *cis*-$[Pt(H_2O)Cl(NH_3)_2]^+$, has a half-life of 2 hrs. Because water is a better leaving group than chloride, these hydrolyzed products are powerful electrophiles that can react with any nucleophilic centre of biomolecules.

Furthermore, the platinum complex's positive charge attracts it to the negatively charged nuclear DNA, where it makes coordinate bonds with the nitrogen groups of the DNA bases.

Nonetheless, *in vitro* investigations have shown that monoaquated complexes are more reactive to DNA binding than diaquated complexes [9].

Due to the chelating leaving groups, opposite to the firmly attached am(m)ine groups, *carboplatin* and *oxaliplatin* are substantially more stable to aquation.

As a result, when compared to *cisplatin*, such chelating ligands imparts a longer half-life in terms of aquation, ranging from weeks to months.

The active drug i.e. aquatic *cisplatin* not only form nuclear DNA (N-donor) adducts, but also can interact with proteins and many other biomolecules. Especially soft S-donor biomolecules are abundant in body as amino acids (L-methionine, L-cysteine), proteins (albumin), and peptides (glutathione), which have very high interest to attached to soft Pt (II) metal center following HSAB theory.

The circulation of Pt (II) drugs in the body, the therapeutic efficacy, the mechanism of metabolism, and the serious toxic side effects are all manifested by its reactivity towards S-containing biomolecules [10]. This affinity of sulphur for Pt (II), has also led to the development of so-called 'rescue-agents' that reduce the negative effects of Pt therapy without lowering its anticancer effectiveness. The protective action of these chemicals is due to the blocking or reversal of Pt-S adducts in proteins, which induce unfavorable toxic consequences.

However, the main target of *cisplatin* is DNA. Only a small percentage of cellular *cisplatin* binds to nuclear DNA, destroying the double helix structure.

Therefore, DNA interaction with *cisplatin* causes biological activities that can result in cell death. It is well established that among the different possible routes of *cisplatin*-DNA interaction, the most important one is the intrastrand cross-linking by two adjacent guanines (G) from single DNA strand.

The N7 atom of purines in DNA is covalently bonded to

Pt (II) an extent about 65%
1,2-intrastrand d(GpG), 25%
1,2-d(ApG), and ~5–10%
d(GpNpG) 1,3- intra-strand

(one DNA strand) crosslinks (p = linking phosphate group, dG = 2'deoxyguanosine and 'N' is any intervening nucleotide) [11].

Mono-functional binding, inter-strand crosslinks (two DNA strands), and DNA-protein crosslinks are examples of other binding patterns.

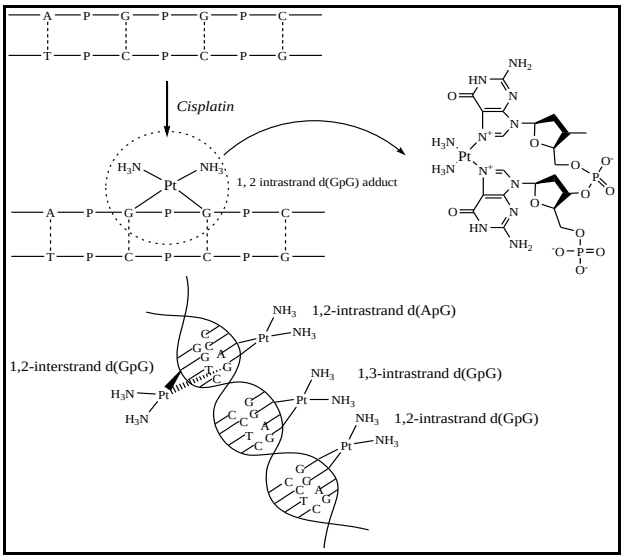

Fig. 2: Schematic representation of DNA-*cisplatin* interactions and types of crosslinks

The following is the decreasing order of reactivity of DNA bases: guanine-N7 >> adenine-N7 > cytosine-N3. As a result, the N7 position of guanine, which is exposed in the major groove, is the most nucleophilic site on DNA, and these sites are preferentially bonded with platinum. The intrastrand crosslinks deforms the structure of the DNA duplex and change its interactions with proteins, thus preventing the replication and transcription of DNA, as well as the DNA repair mechanisms. That crosslink creates a significant kink in the DNA helix axis, ranging from 30 to 80º depending on the experimental conditions, and gives DNA a different shape than non-platinated DNA. Such bending sterically prevents the DNA-polymerase enzyme and probably interrupts the polymerase activity. The structure–specific recognition protein 1 (SSRP1) comprises a high mobility group (HMG) DNA-binding motif and binds to particular *cisplatin*-DNA adducts with great affinity. HMG-domain proteins recognise 1,2-intrastrand adducts generated by *cisplatin* on DNA but not those created by *transplatin*, implying that 1,2-intrastrand cross-links are the predominant DNA adducts involved in *cisplatin's* mechanism of action. They can prevent DNA repair enzymes from recognising *cisplatin*-DNA adducts, regulate cell cycle events after DNA damage, and cause cell death (apoptosis).

In response to the formation of a *cisplatin*-DNA adduct, cells activate various repair pathways, the most important of which is the nucleotide excision repair pathway, which detects and repairs *cisplatin* lesions. To remove *cisplatin* damages, two major nucleotide excision repair routes, transcription-coupled repair (TCR) and global repair (GR), have been established [12].

Despite its efficacy against some cancers, *cisplatin's* curative potential is limited due to acquired drug resistance and significant adverse effects. Reduced drug import, increased drug efflux, multiple cellular self-defence adaptations, inactivation by proteins (e.g., metallothionein), cytosolic detoxification (primarily by glutathione), and increased DNA damage repair or tolerance are all factors that contribute to *cisplatin* resistance in tumour cells (reduced accumulation of the compound). *Cisplatin* is also linked to nausea, cardiotoxicity, hepatotoxicity, neurotoxicity, ototoxicity, peripheral neuropathy, myelosuppression, and nephrotoxicity, among other adverse side effects. Furthermore, *cisplatin* can cause damage to non-targeted tissues, suggesting that the drugs' long-term erratic effects are one of the causes of mortality among cancer survivors later in life.

The hunt for new anticancer platinum complexes with improved efficacy has been stimulated by these pharmacological shortcomings. *Carboplatin* was the first derivative (modified leaving group) with a more tolerable toxicological profile, although it also has *cisplatin* cross-resistance. *Carboplatin* alone, on the other hand, has a reduced nephrotoxicity due to its slower rate of conversion to active platinum aquo species. *Oxaliplatin* can overcome *cisplatin* resistance when combined with modified non-leaving spectator ligands.

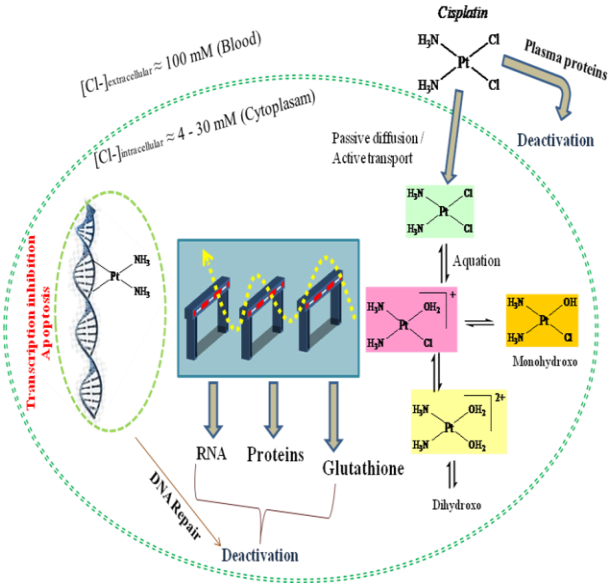

Fig. 3: The plausible *in vivo* reactivity of *cis*-DDP and hurdles faced by drugs before reaching DNA.

2.3 Trans platinum (II) complexes

Platinum(II) complexes with trans geometry were once thought to be ineffective. *Transplatin's* inactivity is hypothesized to be caused by two main causes. Because *trans* chloro species are kinetically more reactive than their analogous *cis* isomers, unwanted reactions could have an impact in the lack of therapeutic activity, at partly. The failure to produce significant cytotoxic DNA lesions is due to the stereochemical inaccessibility of trans isomers to the 1,2-intrastrand cross-link between neighbouring purines. In the 1990s, however, the apathy regarding *trans*-platinum complexes faded. Several trans-platinum complexes having significant anticancer efficacy in vitro against diverse tumour cells, including *cisplatin*-resistant cell lines, were produced. Some transplatin derivatives containing planar amines (e.g. pyridine, quinoline, thiazole, imidazole), iminoethers, aliphatic amines (isopropanamine, n-butanamine, dimethylamine), and nonplanar heterocyclic ligands (pipreridine, piperazine), as well as polynuclear complexes, have demonstrated positive sensitivity in vivo. In certain cases, these compounds are as hazardous as or more toxic than cisplatin, one of the most effective anticancer drugs. Furthermore, several trans-platinum complexes have a high level of cytotoxicity against cisplatin-resistant tumour cells. These complexes could be the key to overcoming cisplatin resistance, whether intrinsic or acquired, in the near future [13].

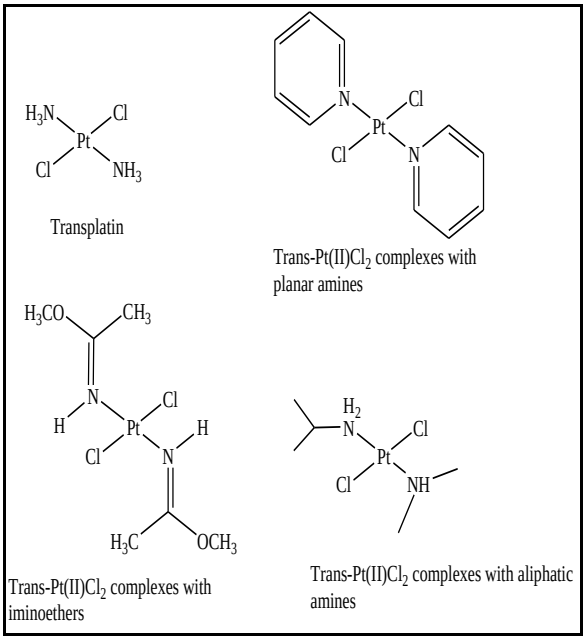

Fig. 4: Chemical structures of some antitumor-active *trans* complexes

2.4 Pt (IV) coordination complexes as prodrug

The improved stability and bioreductive activation of platinum (IV) anticancer drugs contribute to many potential advantages over platinum(II) in the treatments of anticancer. Moreover, Platinum (IV)-based anticancer drugs are octahedral and less susceptible to substitution reactions, thereby arrived at their cellular target with a greater proportion, therefore lowering adverse effects and drug degradation. Some platinum (IV) complexes have a low toxicity profile, do not show cross-resistance with cisplatin, and can be administered orally. Platinum (II)-based anticancer drugs, on the other hand, are associated with high reactivity and, as a result, low biological stability. *In vivo*, reductive elimination to platinum (II), activates the octahedral platinum (IV) complexes, making them kinetically more labile platinum (II) complexes. The platinum (II) complexes can then bind to DNA, generating intrastrand and/or interstrand adducts, which prevent replication and transcription [14].

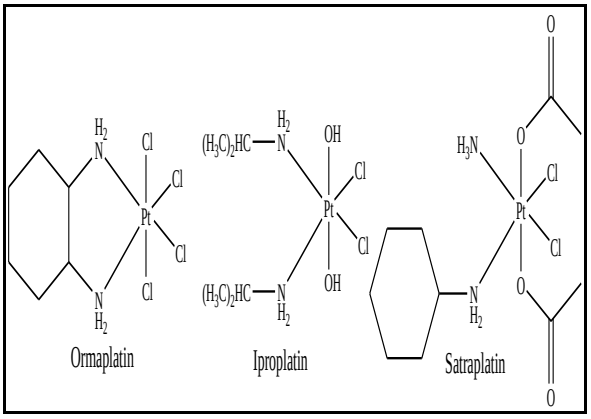

Fig. 5: Chemical structures of some platinum(IV) compounds that have entered clinical trials

2.5 Palladium

Palladium and platinum share a striking resemblance in coordination chemistry due to their most common oxidation state, +II, in which they exhibit a diamagnetic d^8 electronic configuration. Pd (II) and Pt (II) complexes are usually square planar. Studies of Pd (II) complexes as antitumour drugs have been proposed based on the structural and thermodynamic similarities between platinum(II) and palladium (II) complexes. The ligand-exchange kinetics is an essential component that may explain why platinum is suitable. Pd (II) complexes are generally thermodynamically and kinetically less stable than Pt (II) complexes. Pd (II) compounds exchange ligands at a rate of 10^4–10^5 times faster than their platinum

analogues. Palladium complexes easily dissociate *in vivo*, resulting in highly reactive species incapable of reaching their pharmacological targets. Furthermore, some palladium complexes can undergo to form an inactive trans-conformation. The equivalent *cis*-$[Pd(NH_3)_2Cl_2]$ has little antitumoral efficacy when compared to *cisplatin*.

Owing to higher reactivity palladium complexes, if an antitumour palladium drug is to be designed, a strongly coordinated nitrogen ligand and a suitable leaving group must be used to make it inert. If such groups are relatively inert, the drug can maintain its structural integrity *in vivo* for an extended period of time.

Palladium complexes comprising aromatic N- and N,N-containing ligands, such as derivatives of pyridine, quinoline, pyrazole, and 1,10-phenanthroline, as well as N,S-chelating ligands, such as derivatives of thiosemicarbazones and dithiocarbamates, have shown promising anticancer activities [15].

The cytostatic and cytotoxic actions of Pd (II) complexes have been compared to those of cisplatin in several investigations. Furthermore, Pd (II) complexes appear to have higher solubility and less nephrotoxicity (attributed by the inability of proteins in renal tubules to replace strongly bonded chelating ligands of Pd (II) with sulphydryl group), making them more viable antitumour agents.

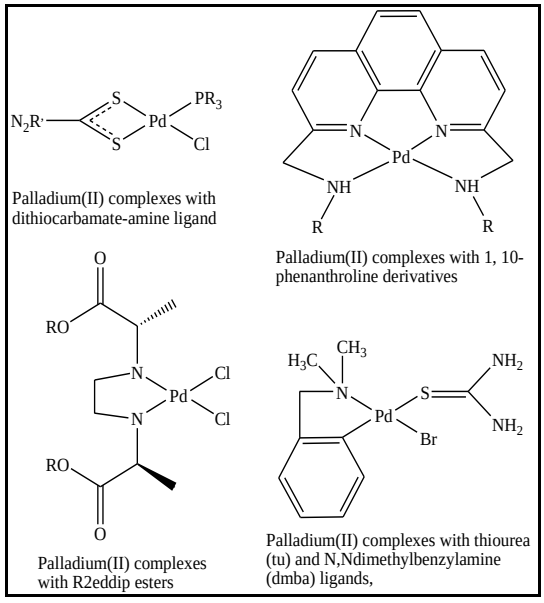

Fig. 6: Chemical structures of various antitumor-active palladium complexes

2.6 Ruthenium

In the recent decade, ruthenium anticancer medicines have received a lot of attention, and a few of them have even advanced into clinical trials. Unlike platinum-based therapeutics, ruthenium complexes are usually found to be less toxic and capable of overcoming platinum-induced resistance in tumour cells. Ru (III) and Ru (II) have interchangeable oxidation states, allowing for a wide range of ligand combinations, and ruthenium compounds' intrinsic fluorescent characteristics and kinetic inertness are extremely valuable in biological research. The ability of Ru (III) to mimic iron binding serum protein, decreasing free plasma ruthenium and increasing the concentration that reaches cancer cells when compared to healthy cells, is largely responsible for probable anticancer activity of ruthenium compounds.

Moreover the biological activities of ruthenium compounds are attributed by the transportation to tumour cells by transferrin and following reduction to more labile and reactive Ru (II) analogues, a process more pronounced in the hypoxic environment of solid tumour cells, thus offering selectivity and subsequent lower toxicity.

NAMI-A and KP1019 are two leading ruthenium based drug candidates possessing antitumor activities. The anticancer activities of the ruthenium (III)-containing NAMI-A complex (imH)[*trans*-$RuCl_4$(DMSO-S)(im)], where im = imidazole and DMSO = dimethylsulfoxide, have been intensively investigated. Clarke and coworkers developed NAMI-A (New Anti-tumour Metastasis Inhibitor, and A stands for the first of a series) in the 1980s, which inhibits cell proliferation and metastasis [16].

KP1019, on the other hand, is a *trans*-$[RuCl_4(Ind)_2]$IndH that causes apoptosis via the mitochondrial pathway.

Organoruthenium compounds have recently been exploited to imitate the structure of staurosporine (a natural protein kinase inhibitor) in an attempt to target the BRAF serine/threonine kinase, which is prevalent in many human malignancies.

Despite being substitutionally very inert, organometallic half-sandwiched (η^6-arene)Ru(II) compounds containing imidazole, sulphoxide, chelating amino acidato, and diamine or diimine ligands are very cytotoxic against various human tumor cell lines [17].

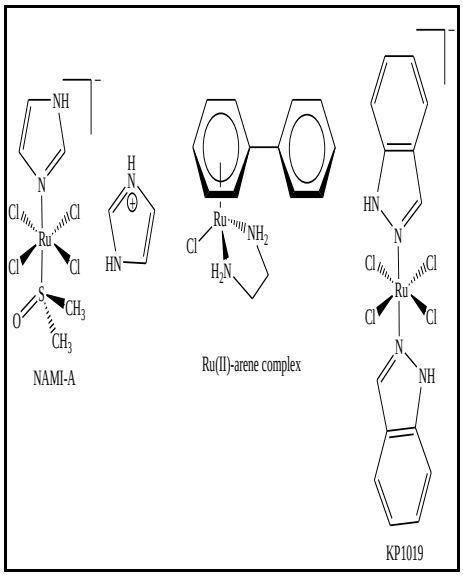

Fig. 7: Structures of some ruthenium complexes

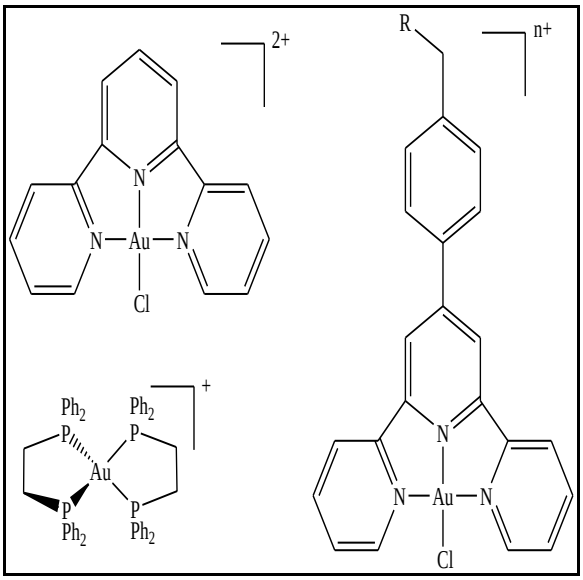

Fig. 8: The structure of some gold complexes

2.7 Gold

Clinical applications of gold complexes (e.g., Auranofin) were mainly confined to the treatment of rheumatoid arthritis, due to their immunosuppressive and anti-inflammatory properties. Gold (I) and gold (III) complexes have gained a lot of interest among non-platinum anticancer drugs due to their significant activity, which is usually achieved by establishing non-cisplatin-like mechanisms of action as the target location of such complexes is mitochondria, not DNA. Recent research has shown that macrocyclic gold (III) complexes with a quinoxaline moiety increase DNA intercalation and subsequent cytotoxicity [18].

Moreover, gold (III) and platinum (II) have the similar d^8 electronic configuration, thus reflects comparable physicochemical and geometrical properties. The correlation between cancer and inflammation, along with the aforesaid chemical features made gold complexes suitable applicants for choosing as anticancer compounds. Many gold complexes in different oxidation states have displayed antiproliferative effects including phosphine complexes.

In A2780/S cell lines, the 2,2':6',2''-terpyridine gold (III) complex $[Au(terpy)Cl]Cl_2$ has exhibited significant activity [19]. Concomitant use of gold nanoparticles with radiotherapy or chemotherapy enhances DNA damage and makes the treatment more targets specific.

2.8 Copper

The essential trace element-copper plays central role in various physiological cellular processes. However, its high redox activity and affinity for binding sites that could otherwise be occupied by other metals makes copper cytoxic. Moreover, the process of angiogenesis, proliferation, and migration of endothelial cells requires copper. Increased copper levels, on the other hand, promote tumour growth and metastasis.

Copper is known to form a wide range of coordination complexes with the oxidation states Cu (I) and Cu (II), as well as few copper (III) compounds. Copper's coordination chemistry is mostly confined to Cu (II) derivatives and a few Cu (I) compounds. Copper (I/II) complexes are reactive, labile, and prone to form deformed coordination geometries. Copper complexes can interact with DNA *via* surface association or intercalation, particularly bind to the N7 reactive center on purine residues of DNA, significantly increase reactive oxygen species (ROS) production, and trigger DNA damage with proliferative arrest. Several copper-based anticancer agents have been reported to have distinct mechanism from current platinum drugs, and might overcome drug resistance.

The development of copper complexes as anticancer drugs is based on differences in tumour cell metabolism and variations in normal and tumour cell responses to copper. Various Cu complexes produced with different sets of N, S, or O ligands have shown substantial cytotoxicity and anticancer activity [20].

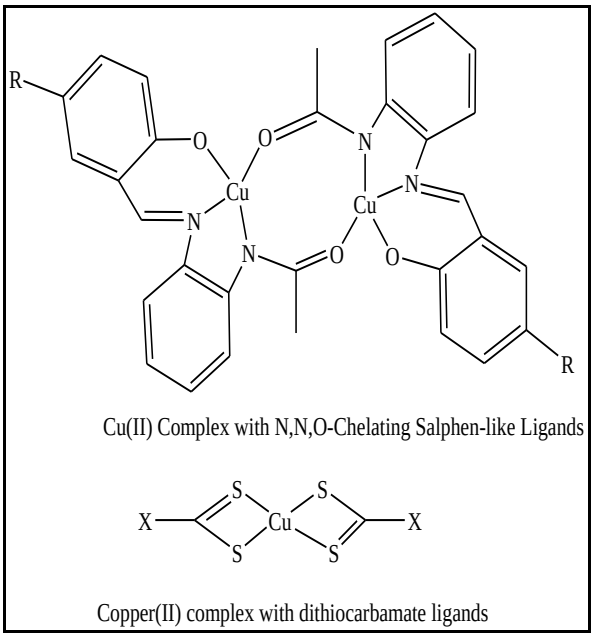

Fig. 9: The structure of some copper complexes with anticancer activity

2.9 Iridium

Immediately after the accidental discovery of *cisplatin*, the iridium complexes were first screened for antitumor activity. $5d^8$ Ir (I) compounds with square-planar geometry comparable to cisplatin, such as [Ir(acac)(cod)] and dinuclear $[IrCl(cod)]_2$, were explored for their anticancer effects in the 1970s.

Organo-Ir (III) anticancer drugs have shown significant antiproliferative efficacy against a variety of cancer cells in recent years [21]. Iridium (III) is third row low spin d^6 metal ion and it is often considered as one of the most inert ion in the biological system. The aquated iridium (III) ion, $[Ir(H_2O)_6^{3+}]$ has an extremely low water exchange rate constant k_{ex} 10^{-10} s^{-1}, which does not make it promising. However, when three of the facial water molecules of $[Ir(H_2O)_6^{3+}$ were substituted with a cyclopentadienyl ligand (Cp), the residual bonded water molecules had a 14 times higher exchange rate than those of $Ir(H_2O)_6^{3+}$. Because of the increased water exchange rates for bonded Cp ligands, many Ir(III) 'half-sandwich' molecules containing a Cp ligand have recently been prepared and screened for anticancer activities [22].

As a result, inertness and stability are the guiding criteria for rational drug modelling, allowing the complex to reach its target site without being altered. Furthermore, the associated ligands could play a function in target-site recognition.

Cancer cells are preferentially damaged over nontumorigenic cells by dual-targeting organometallic half-sandwich iridium(III) anticancer complexes, which have no cross-resistance with *cisplatin* [23]. Furthermore, by triggering nuclear DNA damage and mitochondrial malfunction via synchronous ROS production, these complexes promote cell apoptosis. In summary, iridium complexes have a low toxicity profile and are water resistant.

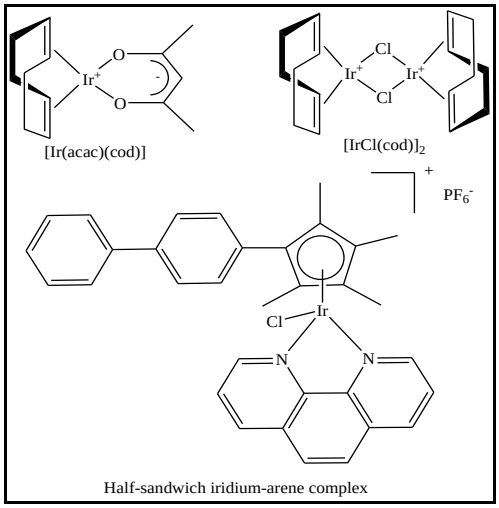

Fig. 10: The structure of some iridium complexes with anticancer activity

2.10 Rhodium

Like iridium (III), rhodium (III) metal centers are also kinetically inert for drug development and to show biological activity. In fact, rhodium (III) complexes with ammonia or imidazole ligands that are isostructural to antitumour-active ruthenium (III) compounds, such as KP-1019, undergo exchange reactions more slowly and are biologically inactive than their ruthenium (III) analogues. A series of rational approaches have been designed to enhance the biological activity of rhodium complexes. The first is to introduce one or more ligands with a strong *trans* effect to increase the kinetic lability of the opposite ligand, such as chloride. For example, the "half-sandwich" (three-legged piano–stool complexes have a pseudo-octahedral geometry at the metal centre, with three monodentate ligands or one bidentate and one monodentate ligand occupying the three legs) rhodium complexes with monodentate halide ligand can contribute a kinetically labile site for substitution reactions for target molecules, which is responsible for their observed anti-cancer activity [24].

A second strategy is to introduce cytotoxic ligands that can potentially participate in specific interactions with different biomolecules. This could explain the excellent cytotoxic activities of several rhodium complexes containing polypyridyl ligands through formation of stable intercalative binding with DNA or groove binding. The use of metal complexes as structurally inert scaffolding for enzyme inhibitors is a third approach. The spatial distribution of the substituents around the metal core is more flexible in this regard, increasing the possibility of constructing complex three-dimensional enzyme inhibitor complexes [25]. Metal does not play a direct part in the inhibition here; it just allows the substituents to be distributed spatially around the metal centre. Protein kinases, which are known to regulate many aspects of cellular physiology, are the preferred targets of such complexes. Furthermore, inhibitors are very selective because organic ligands are arranged in such a way that they occupy the open space at the active site while simultaneously interacting with hydrogen bonds.

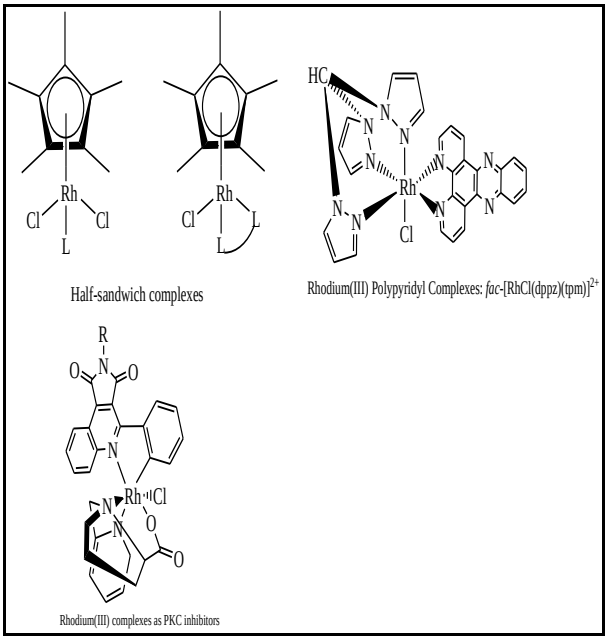

Fig. 11: The structure of some rhodium complexes with anticancer activity

2.11 Osmium

Osmium is the heavier congener of ruthenium, therefore it is logical to assume that osmium-containing complexes will have anti-cancer characteristics similar to ruthenium-containing complexes. Osmium, on the other hand, has various advantages over ruthenium, including a preference for higher oxidation states, slower ligand exchange kinetics, and stronger -back-donation from lower oxidation states. In addition, the three-dimensional spatial arrangement of osmium compounds (usually CN 6) complements molecular targets like proteins and DNA sites in a sequence-specific manner. Osmium compounds in various oxidation states are said to have a key role in biological redox regulation in cancer cells. Os (II/III)-based anticancer complexes, such as Os-NAMI-A, were developed as congeners of the well-studied Ru (II/III) complexes. The selective anti-proliferative actions of analogue osmium compounds are comparable to or greater than that of parent ruthenium structures [26]. FY26, an organometallic arene-Os (II)-azopyridine molecule with anticancer activity comparable to cisplatin and carboplatin and a novel anticancer mechanism of action, has been discovered. FY26 is a powerful prodrug that can be catalytically activated by cellular glutathione (GSH) and significantly raises intracellular reactive oxygen species (ROS) levels in cancer cells. Excess ROS can cause cell death by activating pathways that lead to apoptosis, necrosis, and autophagy, causing more toxicity towards cancer cells than normal cells.

Other Os (II) polypyridyl complexes have shown biological activity, however due to lack of labile ligands, they bind to intracellular targets via non-covalent interactions.

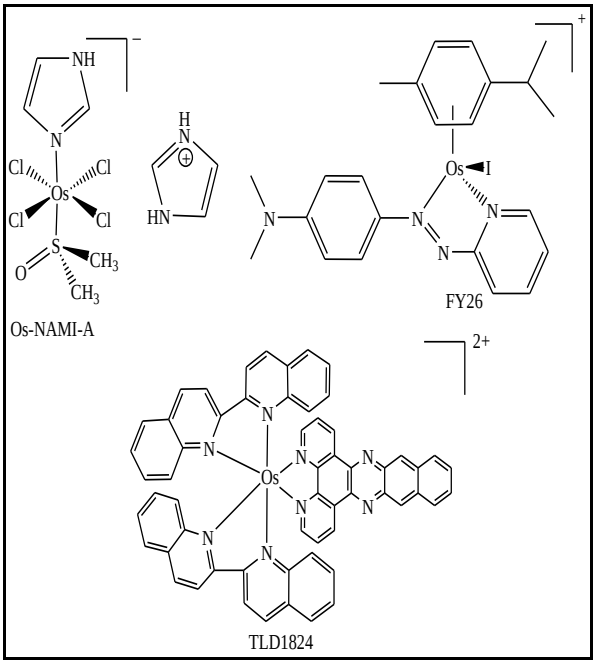

Fig. 12: The structure of some osmium-based anticancer agents

3. CONCLUSION

The success of cisplatin has prompted scientists to synthesize a huge number of metal complexes and examine them as antitumor drugs, with the primary goal of overcoming the limitations of currently used metallodrugs. This paper discusses a number of transition metal-based promising therapeutic agents, all of which are cytotoxic and exhibit DNA intercalation. Moreover, the prior structural and charge requirements for an active anticancer complex have been questioned, resulting in the appearance of a large variety of potential metal complex candidates. Metal complexes can also provide a wide range of structural variety and the possibility of ligand exchange, allowing for host-guest interaction, coordinated bonding with cellular biological targets, and redox activity focused on the metal or the ligands.

Transition metal complexes other than Pt with different modes of action and/or cellular targets can be used in combination with existing therapies like *cisplatin* to alleviate some of the clinical drawbacks. The unique features of metal complexes with various biological targets and modes of action can be utilized to develop novel drugs.

The numerous combinations of transition metal and ligand have resulted in a diverse range of anticancer complexes, each with its own mechanism of action.

The ongoing growth of this library holds considerable promise for the discovery of novel transition metal-based compounds that can outperform current metallodrugs and deliver more effective chemotherapeutic agents.

4. ACKNOWLEDGEMENTS

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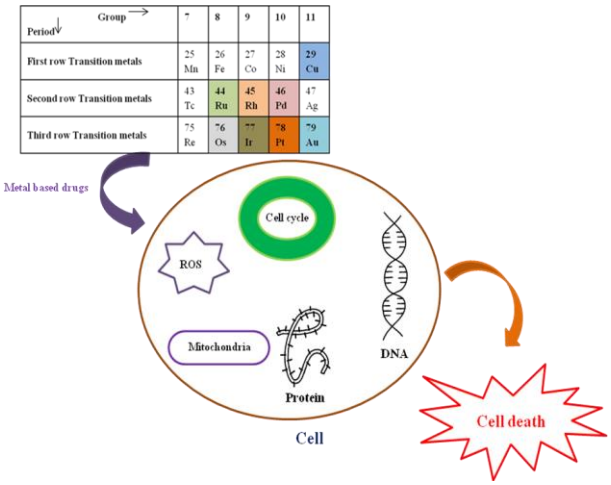
Graphical Abstract



A STUDY OF VARIATION IN THERMOELECTRIC CHARACTERISTIC OF BI_2TE_3-PANI UNDER THE INFLUENCE OF VARIOUS AMOUNT OF SELENIUM DOPING

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Abstract. *The electrical conductivity of Polyaniline (PANI) increased immediately with the increase in temperature (the electrical conductivity value of 28 ° C is 0.21 w / cm) cm. Seebeck coefficient decreases with decreasing temperature. Together these two properties indicate that PANI can be used as a P-type semiconductor polymer material and a thermoelectric (TE) material. There is great interest in thermoelectric materials for energy production and storage, and in many cases, including thermal formulations, tellurium is very attractive. To get a clear understanding of this we choose bismuth telluride. Combined with the PANI, the telluride induced (Bi_2Te_3-PANI) exhibits internal thermoelectric properties at room temperature that can be used as any thermoelectric component. Although the electrical parameters and conductors of Seebeck are may be considered unsatisfactory for Bi_2Te_3-PANI. To solve these problems, we modified the entire formulation with different amounts of selenium and attempted to understand the changes in the thermoelectric properties (TE) of Bi_2Te_3-PANI.*

Keyworks: *Bi_2Te_3-PANI, Thermoelectric property, Doping.*

1.INTRODUCTION

The state of energy production and use is an undeniable problem today; Fossil fuel-based energy production needs to be replaced by green, non-polluting methods [1]. Even when these energy sources cannot be replaced, increased efficiency is of paramount importance in both production and use. Thermal electricity (TE) provides a method for exploring both energy production and energy efficiency. By reducing the efficiency due to lower heat loss, the thermoelectricity can be used either as direct power generators or as the thermoelectric or used to increase the efficiency of other established methods [2]. Whether small or large in size, thermoelectricity provides a solid and solid state method for converting heat energy into electrical energy, and it is easy to use and transport [3].

Due to their amazing internal thermoelectric properties at ambient room temperatures, Bismuth telluride (Bi_2Te_3) thin films have been studied in depth by several research teams [4]. To increase the TE property of bismuth telluride, the scientists modified a variety of factors, including chemical composition, crystal phase, crystallization, charge carrier concentration, and steroids [5].

The efficiency of a substance after the thermoelectric conversion can be measured using thermoelectric figure of merit ZT, defined as (σS^2) T⁄κ (where T = absolute temperature and σ = total thermal conductivity) . During maintenance of optimum σ value, the increased S increases the power factor (σS^2), is a key approach for achieving high efficiency thermoelectric materials [6].

One strategy to achieve this is to manufacture inorganic biological formulas. So far, researchers have discovered inorganic organic compounds such as poly (3,4-ethylenedioxythiophene): poly(4-styrenesulfonate) (PEDOT:PSS)/graphene PEDOT: PSS/Te nanorods, PEDOT: PSS/Sb_2Te_3, PEDOT: PSS/PbTe, PEDOT: PSS/Bi_2Te_3, PEDOT: PSS/Ge, P_3HT/Bi_2Te_3, and Polyaniline (PANI)/carbon nanotubes (CNTs) to achieve high-energy components [7]. Among the conductive organic polymers, PEDOT: PSS has relatively high stability and environment. Although PEDOT: PSS value is slightly lower than that of inorganic materials, it is relatively non-toxic, abundant and low which will provide higher ZT phase and liquid organic polymers [8].

The mixture is then poured at a formal level before the electrothermal properties are measured. In this case, the thermoelectric properties of the compounds (S and σ) are described according to the filtration effect by the inorganic bio-method.

Here in this research work, we have used pure PANI and Bismuth telluride to produce a composite of Bi_2Te_3-PANI. The thermoelectric behavior of the above mentioned composite and observation shows an increased rate of electrical conductivity in compare to pure PANI. Then we have doped the composite using different amount of Selenium to further increase the rate of conductivity. Hence we can have a good TE material.

2.EXPERIMENTAL METHODOLOGY

2.1. Pure polyaniline polymer (PANI) synthesis

Chemical oxidative method was used for the production of PANI. In acidic aqueous medium Aniline was oxidized with ammonium persulphate [9] after which it was dissolved in double distilled water and HCl separately. The solvents are then mixed thoroughly at room temperature. The mixture was then stirred for one hour and kept for polymerization. Filter paper was used to collect the PANI precipitate following which the precipitate was using HCl, distilled water, and methanol respectively. The PANI powder was then dried in vacuum. The Bi_2Te_3 are purchased in the powder form from Sigma company with 99.99% purity.

2.2 Bi_2Te3-PANI synthesis

The nanocomposites were prepared in order from the liquefied. The aniline solution was mixed Bismuth telluride which was followed by constant stirring for 30 min. This resulted in the change of color of the solution to blackish. After that APS was added as an oxidant followed by stirring of the mixture at temperature range of 0^0C and 5^0C for 6 h for the polymerization to take place. The mixture was then vacuum dried at 5^0C for 24 hours in an oven. The resultant precipitate that was obtained was blackish green color PANI-Bi_2Te_3 nanocomposite [11].

2.3 Se Doping

Se displays photovoltaic properties, where light is transformed straightly into electricity and we get photoconductive action in which electrical resistance reduces with increased illumination. Selenium a doped polymers show extensive properties as superconductors [4].

In this research and paper, we have doped Bi_2Te3-PANI with different concentrations of the synthetic selenium (5%, 10%, 15% and 20%). Selenium dissolved in chloroform is added to the swollen vessel (swollen with the effect of the solvent) and stirred for 24 hours at room temperature in different proportions. Dry the anesthetic mixture and then finally grind to form the sample.

3. CHARACTERIZATION

The electrical conductivity of these samples is measured at temperature of 300-450 K. The samples were placed between two steel electrodes, located inside the metal sample container to measure the conductivity. To avoid the effect of moisture absorption, samples were annealed prior to the conductivity measurement at a vacuum of 10^{-3} Torr. Temperature measurements are performed by means of a cribble chromal alumel thermocol fixed near the samples. A voltage of 1.5V was applied (via a controlled DC source) to the samples and the resulting current was measured using a 6157A boiler electrometer. Thermal analysis was performed by a differential scanning calorimeter (Model - DSC Plus, Rheometric Scientific Co. UK).

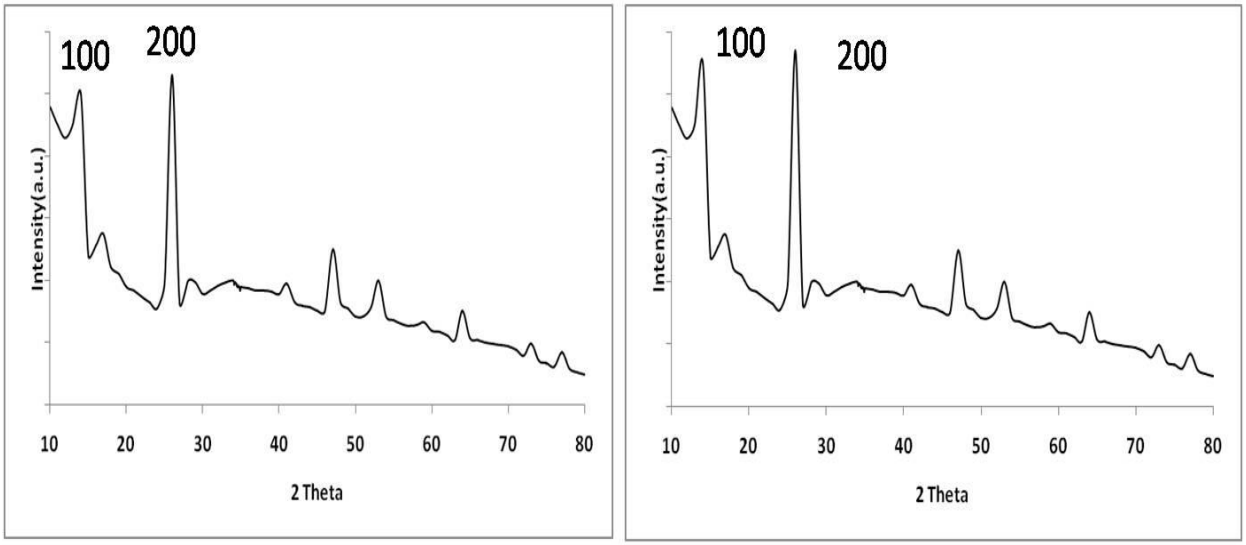
The accuracy of temperature for this device is ±1ºC. For undoped and Se doped Bi_2Te3-PANI samples DSC scans were taken at 10ºC/min heating rates. The temperature in the DSC ranged from 36°C to 180°C. In order to endure UV visible absorption profiles the polymer was dissolved in chloroform. The Compaq M-550 dual-beam scan was used for the visible UV spectrum. Sample morphology was studied using a Scanning electron microscopy (SEM) using a JOL JSM 6380 SEM at 10 KV. FTIR spectra from doped and unplanned PANI-KBR granules with Parkinelma were obtained from in quantities ranging from 400 to 4000 cm^{-1} with a resolution of 4 cm^{-1}.

4. RESULTS AND DISCUSSIONS

For Fig.1, XRD patterns are shown for Bi_2Te_3-PANI and 5% Se doped Bi_2Te_3-PANI. The units associated to Bi_2Te_3-PANI pattern are evidently observable. Compared with the original manufacturer, the related single peak occurs in the same location which can be

clearly observed from the XRD pattern of Bi_2Te_3-PANI group. There has been correlation observed among single peak observations with the repeating unit of Bi_2Te_3 among the Doped Bi_2Te_3-PANI and Penny matrix. This specifies that Se doped Bi_2Te_3-PANI and Bi_2Te_3-PANI give rise to an well-ordered Bi_2Te_3molecular arrangement in a triple combination [12].

FTIR spectra of the unopened and doped Bi_2Te_3-PANI were found with different Se concentrations. Here we only show the 5% IR spectrum of the doped Polyaniline telluride in Fig.2.



A **B**

Source: Realized by author

Fig 1. (**A**) = XDR pattern of Bi_2Te_3-PANI and **(B)** = XDR pattern of 5% Se doped Bi_2Te_3-PANI

Counting doping did not observe Bi_2Te_3-PANI band split. Since it does not show specific absorption bands between 400 and 4000 cm^{-1} in the spectrum, it shows absorption only in the infrared range (400-200 cm^{-1}) [13], so the observed bands are compatible with Bi_2Te_3- PANI only. However, the inclusion of selenium in the polymer induces smaller shifts of some FTIR peaks in the pan. The intensity of the peaks follows the same pattern as shown by measuring the band gap as well as DC conductance.

There are five vibration bands for the Bi_2Te_3- PANI spectrum which are 1470-1510 (stretching vibration of benzene ring), approx 1300 (stretching vibration of CeN), 1560-1610 (stretching vibration of quinoid ring), approx 1140 (characteristic vibrational mode of quinoid ring) and 1–30 rotation (out-of-plane bending vibration of CeH on para-disubstituted rings)[14]. The same pattern of peaks was observed by Se doped Bi_2Te_3-PANI emeraldine base films [11].

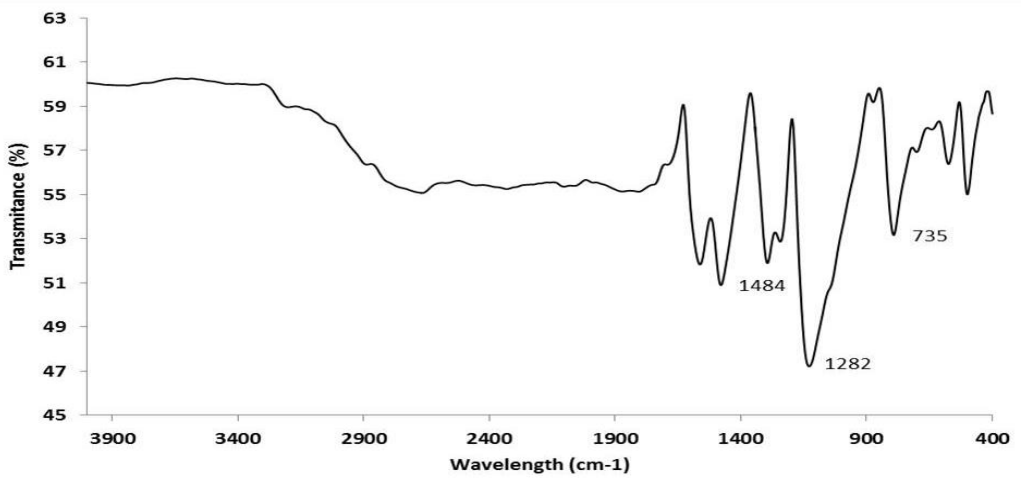
Conductivity is a significant feature that exposes the significant and tenacious evidence regarding the transport occurrence and considerable properties of the substance.

The DC conductivity is expressed through the relation [15].

$$\sigma_{dc} = \sigma_o \exp(-\Delta E/k_b T) \quad (1)$$

where: ΔE is the activation energy,
σ_o is pre-exponential factor,
and k_b is the Boltzmann constant.

The straight line plot of σ_{dc} describes that conduction in Bi_2Te3-PANI is taking via an activated process with unique activation energy in the range of 300-450 K (Fig. 3). The slope of the graph can be used to determine the activation energy.

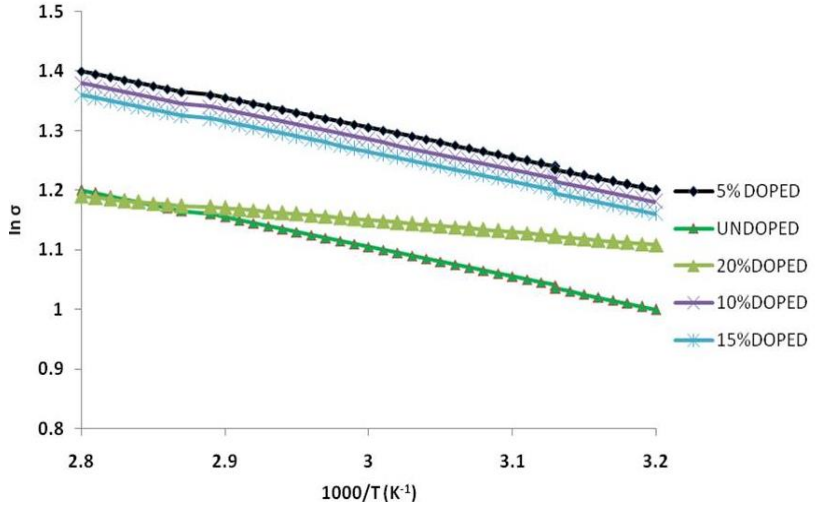


Source: Realized by author

Fig 2. FTIR spectra of 5% doped Bi_2Te_3-PANI nanocomposite

Figure 4 shows the DC conductivity density and activation capacity against the Dopant graph. It is evident from Fig. 3 that the conductivity increases with increasing the selenium concentration by up to 10% and decrease immediately by 15-20%. Conductivity increases in a sequence of three levels up to 5% of the anesthetized sample and decreases again with increasing density as the activation energy decreases. The increase in DC conductivity with a decrease in the activation strength appears to be related to the change in the Fermi level in the anesthetized samples. It is quite clear from activation energy that at the Fermi level the movement is along the carrier density.

The information from the ΔE isn't sufficient to understand this transmission in localized states. Other factors such as σ_o are also need to be studied in order to fully understand the phenomenon. Mott and Davis described that [16] the value of σ_o (10^3-10^4 Scm^{-1}) can be indicative of the phenomenon in extended states. A smaller value of σ_o signifies a hopping transmission. In this paper, it has been observed that the values of σ_o are small; indicating that the transmission followed the hopping procedure as a result of the presence of a large spectrum of local states in the sample.

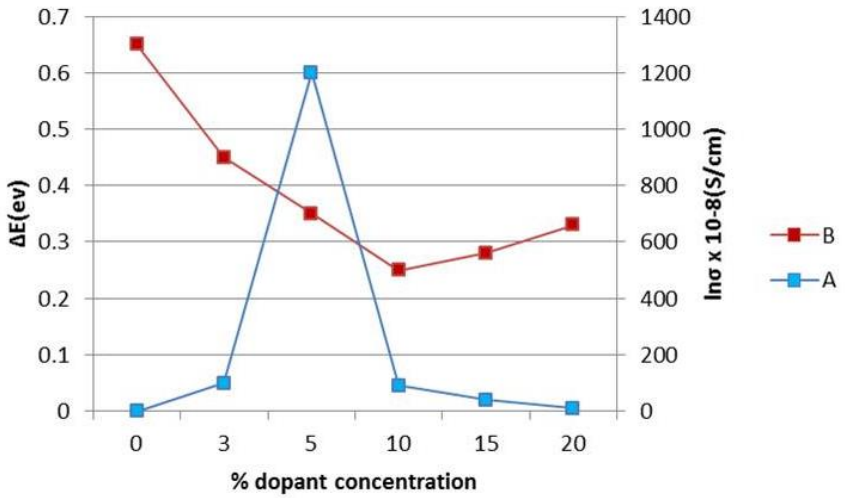


Source: Realized by author

Fig 3. Temperature dependence of DC conductivity with respect to temperature for undoped Bi_2Te3-PANI and Bi_2Te3-PANI doped with different concentrations of Se.

With the findings in the study it can be concluded that the transmission in the material is facilitated by hopping method as a result of which there is an increased conductivity of the Bi_2Te3-PANI [17]. A smaller σ_o value signifies that the thickness of defect states increases in the material which also agrees to the findings that transmission the Se doped Bi_2Te_3-PANI usually occurs by the hopping method.

The bipolarons and polarons configuration can be used to elucidate the mechanism of transmission [17]. Bipolarons and Polarons have an important role in defining the charge injection, transfer properties as well as optical properties of carrying out polymers. When Bi_2Te_3-PANI was doped with selenium, bipolaron, the production happens but with the highest dopant concentration, the conductivity does not amplify because of saturation of charges.



Source: Realized by author

Fig 4. Variation of DC conductivity (A) and Activation Energy (ΔE), (B) versus undoped Bi_2Te3-PANI and Bi_2Te3-PANI doped with different concentration of Se.

5. CONCLUSIONS

The semiconducting Bi_2Te_3-PANI has been successfully manufactured and doped with different density of Selenium. Three orders of raise in conductivity value of was observed following doping. The procedures of conduction have been clarified both on the basis of pre-exponential factor and bipolaron production. From temperature changes it is evident that there is an increase in ΔE initially with an increase in the density of Selenium which is followed by reduction in density. An association has been observed among the enthalpy released and the metastability of polymer [18].

FTIR spectra show the structural variation of Bi_2Te_3-PANI after doping of Se and also verify the merger of Se in polymer chain. The DC transitivity measurements show the Selenium doping amplifies the conductivity up to a specific density of Selenium and then it began to decrease. The substrate conductivity varies with Se. This is because the change of sample conductivity mainly depends on the carrier concentration, degree and carrier mobility. However, the carrier concentration is increased due to the Se doping leading to increased conductivity; but on the other hand, along with increase Se doping amount, the bulk sample grains gradually become smaller, which will introduce more grain boundaries inside the material, and increase carriers scattering, weaken the carrier mobility and as a result, the conductivity of the sample reduces.

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CRITICAL CONCEPTUAL ISSUES AND CROSS-CONTEXTUAL FRAMEWORK OF CONSUMER-BASED BRAND EQUITY (CBBE)

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Abstract. *Brand equity remains contentious in academia as it's vague how brand equity is fostered, controlled, and sustained. This article seeks to assess the research on brand equity, investigate crucial conceptual issues, and provide a cross-contextual framework of CBBE based on theoretical approaches and reasoned logic. A comprehensive and in-depth literature assessment assisted in developing the cross-contextual CBBE framework. The authors conclude that factors pertinent to brand equity (brand awareness, image, and perceived quality) can be adapted to numerous brand types and varied economic sectors. However, these factors should be treated as antecedents of brand equity, not quite as brand equity components. The switchover from composition to decomposition would be a natural transition in developing a brand equity construct. Another essential part of the suggested framework that required prominence was brand loyalty, as loyalty must be considered a possible outcome of brand equity instead of merely a component. This study is among the first to identify significant conceptual challenges affecting CBBE, attempt to fill the gaps in the conversation about developing cross-contextual CBBE, and contribute to the unified branding theory*

Keywords: *Brand equity, Cross-Contextual, Consumer-based Brand Equity (CBBE), Brand Loyalty*

1. INTRODUCTION

As little goes unbranded in today's society, branding is a pivotal yet elusive construct (Davcik *et al.*, 2015; Punj and Hillyer, 2004) [37, 101], and developing a brand is viewed as the most acceptable means of doing business due to the continuous changes in the marketing landscape (Emari *et al.*, 2012) [41].

Building a successful brand is a complex phenomenon, and sustaining that brand over the long term is a challenging endeavour (Chatzipanagiotou *et al.*, 2016) [28]. Firms possessing powerful brands usually have an edge over rivals since such brands can readily be memorized, recognized, and recalled (Hanaysha, 2016a) [50].

As a result, corporate giants are willing to spend millions and do all it takes to build a strong brand (Ahmad & Guzmán, 2020) [4]. Whenever a consumer discovers a product and stores the brand's conceptual understanding in their consciousness for prospective buying decisions, the product turns into a brand (Krishnan, 1996) [71]. Marconi (1993) [80] underlined that the brand is more than just a label; a label merely helps identify the goods, whereas a brand adds value and personality to the product. According to Keller (1993) [62], a brand is a perceptual entity grounded in reality but is more than that and represents the views and maybe even the peculiarities of customers.

Branding has a tremendous potential to amend the way people perceive products, as shoppers seldom see a product or service; they see the product coupled with the brand (Agaba and Kalu, 2019) [2]. Brands hold a unique position in business both locally and internationally. Its value in marketing cannot be underlined enough as it helps firms establish long-term, beneficial relationships with all stakeholders (Umer and Salman, 2019) [118]. One term that sticks out in the literature on branding is brand equity. Everything the business does can build or hurt brand equity, ultimately unlocking the door to competitive advantage (Farquhar, 1988; Keller, 2003) [43, 63].

Brand equity is the inherent attractiveness of a product through a brand (Baumgarth and Schmidt, 2010) [13]. Brands having strong brand equity can help managers savour immense profitability, deeper loyalty, lower exposure to competitor strikes, brand extensions, improved customer response, premium pricing, and optimized licensing opportunities (Aaker, 1991; Gill & Dawra, 2010; Keller, 1993; Kim & Kim, 2005; Morgan, 1999) [1, 47, 62, 65, 86]. Overall, Brand equity is an essential intangible asset of a firm; therefore, developing it is a prudent investment (Rios and Riquelme, 2010) [105].

Authors concur somewhat on the perks of strong equity, yet, no consensus prevails on brand equity's conceptualization & measurement (Christodoulides *et al.*, 2006) [33]. Brand equity still seems to be dubious in academics as it's vague on how brand equity is created, controlled, and managed (Keller, 2003) [63]. Much of the research on brand equity continues to conceive brand equity related factors (e.g., brand awareness, perceived quality) as context dimensions or components and brand equity construct as a composite of these components (Aaker, 1991) [1]. This indirect evaluation method considers only the origins of brand equity instead of brand equity intrinsically (He and Li, 2011) [52], and this technique scarcely reflects the core of brand equity. Usually, when developing a literature review, concepts are initially characterized as components. As the literature evolves, certain elements should be regarded as precursors to better

comprehend the phenomenon under study (Dabholkar *et al.*, 2000) [36].

Another conceptual question concerns the concept of brand loyalty in the context of CBBE. Existing literature (see Table 1) indicate that brand loyalty serves as a dimension, antecedent, and consequence of brand equity (Aaker, 1991; Keller, 1993; Nam *et al.*, 2011; Pappu *et al.*, 2005; Rodrigues and Martins, 2016; Taylor *et al.*, 2007; Villarejo-Ramos and Sánchez-Franco, 2005) [1, 62, 90, 97, 106, 115, 121]. As brand loyalty is a central factor connected with brand equity (Wichailert *et al.*, 2017) [127], there is a need to be more precise about the role of brand loyalty inside this realm of brand equity.

In addition, the formulation of the concept of brand equity is primarily focused on consumer goods (Aaker, 1991; Atilgan *et al.*, 2005; Keller, 1993; Yoo *et al.*, 2000) [1, 10, 62, 130], while the B2B marketing (Biedenbach *et al.*, 2011; Davis *et al.*, 2008) [18, 38] and services have comparatively little influence (Berry, 2000; Kim & Kim, 2005; Krishnan & Hartline, 2001) [15, 65, 71]. In recent times, scholars have altered models of consumer goods in the context of services and B2B marketing, but the outcomes have been inconsistent. Hence, there is a need to uncover some universal factors that are cross-contextual and relevant to different types of brands and economic activity sectors.

The conceptual issues discussed above can be summed up: First, are the relevant factors for CBBE better considered as its components or antecedents?

What role does "brand loyalty" play in conceptualizing brand equity?

Do brand equity factors related to consumer goods also apply to service brands and B2B marketing?

This study's objectives are twofold; firstly, to highlight the significant conceptual issues of brand equity and suggest ways to improve the understanding of CBBE; secondly, to propose a cross-contextual framework of CBBE and contribute to the unified theory of branding. Our study is unique as we integrate and enhance earlier efforts to evaluate CBBE with different approaches. The study commences by discussing the notion of CBBE. It then outlines the conceptual issues and proposes a cross-contextual CBBE framework. In the end, a discussion on the essential lessons learned and benefaction of this work to the marketing literature.

2. THEORETICAL BACKGROUND

The term "brand" is a contextualized construct vulnerable to various current perspectives and notions and ultimately to a never-ending theoretical developmental process (Gabbott and Jevons, 2009) [45]. Though branding is a concept that has been continually evolving, its central purpose remains intact. Brands raise the value of their products beyond their functional purpose to distinguish themselves from a rival (Farquhar, 1988) [43]. The new phrase "Brand Equity" was brought to the marketing literature in the late 1980s and immediately became a topic of interest for marketing professionals and academics. As a result, even after four decades of considerable research, where multiple perspectives and countless definitions have arisen, no consensus has been reached on the conceptualization and assessment of brand equity (Punj and Hillyer, 2004) [101].

A brand is different from a product, and the consumer invests that difference, and most of the definitions of brand equity emphasize this difference (Blackston, 2000) [19]. A generally accepted interpretation arising from marketing research characterizes brand equity as the enhanced worth of a product due to its brand name (Farquhar, 1988; Louis and Lombart, 2010; Mohd *et al.*, 2007; Park and Srinivasan, 1994) [43, 76, 85, 99]. However, the process involved in adding value is complex (Mudambi *et al.*, 1997) [88].

Aaker (1991) [1] and Keller (1993) [62] did remarkable work on brand equity. Both researchers defined brand equity from consumers' perspectives and agreed to approach brand equity as a multidimensional structure; however, neither of the authors devised a measurement scale. According to Aaker (1991) [1], brand equity is a "set of brand assets and liabilities associated with a brand, its name, and symbols, and these assets and liabilities increase or decrease in the value provided by the product or service to the company and its customers." Keller (1993) [62] expounded the term CBBE (customer-based brand equity) and described it as "the differential effect of brand knowledge on consumer response to the brand's marketing." Keller deconstructed brand knowledge into two components: brand awareness and brand image. A further noteworthy contribution to brand equity theory was given by Yoo *et al.* (2000) [130]. They enhanced the Aaker (1991) [1] model by introducing overall brand equity (OBE) as a separate construct. Berry (2000) [15] developed a framework of service brand equity that highlights the paramount importance of customers' service experiences in brand creation. Keller (2003) [63] introduced the most coherent model of CBBE. Keller suggested a link of four steps underpinning brand salience, performance and imagery, judgment and sentiments, and brand resonance for developing a great brand.

While branding has dominated consumer goods marketing, the notion has been reluctant to acquire root in services and B2B marketing. However, studies have been more inclined toward service and B2B branding in the past few years. Over the decades, multiple approaches have been devised to assess brand equity, and academics have made numerous dimensions operational. Still, the common thread of all models is using one or more dimensions of the Aaker (1991) [1] or Keller (1993) [62] model.

2.1 *Brand Equity Measurement*

One of the most significant aspects of brand management is evaluating brand equity (Ahmad & Butt, 2012) [5]. Akin to its theoretical formulation, quantifying brand equity is likewise not a clear and straightforward phenomenon. Multiple approaches to measuring and estimating brand equity lend an additional layer of complexity to the brand equity construct. The numerous factions of the marketing research field have acknowledged two essential viewpoints: the customer and financial perspectives to comprehend brand equity. The financial approach assesses the value of a brand from the monetary aspects. It looks at how much more money a brand name generates for a product (Simon and Sullivan, 1993) [111]. The customer-based approach explores the linkage between the brand and the user, including the repercussions that garner that interrelationship (Aaker, 1991; Cuneo *et al.*, 2012; Pappu *et al.*, 2005; Veloutsou *et al.*, 2013) [1, 35, 98, 119]. Although a financial approach can provide considerably more specific information regarding a brand's valuation, this is not necessarily useful for marketing experts when developing plans (Keller, 1993) [62]. This customer-centric strategy is more realistic since it provides a strategic perspective on consumer behaviour, allowing marketing managers to develop strategies and prepare accordingly (Kim et al., 2008) [68].

Most of the endeavors employ one of two measurement methodologies: (1) the direct (outcome) approach, which assesses CBBE by evaluating the underlying impact of brand understanding on customer reactions to various marketing aspects (Keller, 1993, 2003) [62, 63], and (2) the indirect (dimensional) approach; it considers various causes of CBBE by recognizing and monitoring customers' brand conceptual understanding (Keller, 1993, 2003) [62, 63]. The direct approach concentrates more on assessing a brand's differential and preferential effect and evaluates the whole brand equity (Washburn *et al.*, 2004) [125]. Conversely, the indirect method suggests brand equity as a multifaceted notion that can be assessed by examining its constituents. Put another way, the direct route captures the customers' preferences (Christodoulides *et al.*, 2006) [33], while the indirect approach operationalizes the concept through its representation (Yoo and Donthu, 2001) [129]. Unfortunately, nobody really knows how to blend these elements to create brand equity (Gill and Dawra, 2010) [47]. The worth of a brand should eventually be derived in the market from the words and deeds of consumers, regardless of how the term brand equity is employed or evaluated (Hoeffler and Keller, 2003) [54].

Extant research is replete with various ways of looking at brand equity (see Table 1). An analysis of available literature was undertaken to understand brand equity's known causes, elements, and effects. Due to the many different models associated with brand equity, this study focuses only on what scholars have shown to be most important for developing brand equity.

Study	Context	Country	Antecedents	Brand Equity	Outcomes	Base Conceptualisation
[34] (Cobb-Walgren et al., 1995)	Consumer Goods and Service (Hotel and Cleansers)	USA	Advertising and other information sources	BA, BAs, and PQ	Brand Preference and Purchase Intention	(Aaker, 1991)
[130] (Yoo *et al.*, 2000)	Consumer Goods (Shoes, Camera Film, and Colour Television)	USA	Marketing Mix	BA/BAs, PQ, and BL	OBE	(Aaker, 1991; Keller, 1993)
[15] (Berry, 2000)	Service Companies	USA	Company's Presented Brand, External Brand Communication, and Customer Experience with Company	BA and Brand Meaning	N/A	(Keller, 1993)
[42] (Faircloth *et al.*, 2001)	Consumer Goods (Sweaters)	USA	BAs, BI, and Brand Attitude	Purchase Intention and Willingness to pay the premium	N/A	(Aaker, 1991; Keller, 1993)
[65] (Kim & Kim, 2005)	Service (Restaurants and Hotels)	Korea	N/A	BA, BI, PQ, and BL	Firms' Performance (Sales)	(Aaker, 1991)
[104] (van Riel *et al.*, 2005)	Industrial Goods (Chemical)	Europe, USA, and Asia	Industrial marketing efforts	Product Brand Equity and Corporate Brand Equity	BL	(Aaker, 1991; Keller, 1993)
[121] (Villarejo-Ramos and	Consumer Goods (Washing Machine)	Spain	Perceived Advertising	BA, PQ, BI, and BL	N/A	(Aaker, 1991)

Sánchez-Franco, 2005)			Spending and Price Deals			
[98] (Pappu *et al.*, 2005)	Service (Retail Store)	Australia	N/A	BA, BAs, PQ, and BL	N/A	(Aaker, 1991; Keller, 1993)
[39] (Delgado-Ballester and Munuera-Alemán, 2005)	Consumer Goods (Shampoo and Beer)	Spain	Brand Reliability, Brand Intentions, Overall Satisfaction, and BL	OBE	N/A	(Yoo *et al.*, 2000)
[10] (Atilgan *et al.*, 2005)	Consumer Goods (Beverage)	Turkey	BA, BL, PQ, and BAs	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[124] (Wang et al., 2006)	Service (Financial Institutions)	China	PQ, BSat, BL, and BA/BAs	OBE	Corporate Reputation, CRM Performance	(Yoo *et al.*, 2000)
[97] (Pappu *et al.*, 2005)	Service (Retail Store)	Australia	N/A	BA, BAs, PQ, and BL	N/A	(Aaker, 1991; Keller, 1993)
[39] (Delgado-Ballester and Munuera-Alemán, 2005)	Consumer Goods (Shampoo and Beer)	Spain	Brand Reliability, Brand Intentions, Overall Satisfaction, and BL	OBE	N/A	(Yoo *et al.*, 2000)
[10] (Atilgan *et al.*, 2005)	Consumer Goods (Beverage)	Turkey	BA, BL, PQ, and BAs	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[126] (Wang et al., 2006)	Service (Financial Institutions)	China	PQ, BSat, BL, and BA/BAs	OBE	Corporate Reputation, CRM Performance	(Yoo *et al.*, 2000)
[107] (Ross, 2006)	Spectator Sports	USA	Marketing Mix, Publicity, Actual Experience and WOM	BA, BAs	Team Loyalty, Media Exposure, Merchandise, and Ticket Sale	(Keller, 1993; Yoo *et al.*, 2000)
[34] (Nowak *et al.*, 2006)	Consumer Goods (Wine)	USA	Product Quality, Service Quality, Fair Pricing, and Customer Commitment	OBE	N/A	(Yoo *et al.*, 2000)
[61] (Kayaman and Arasli, 2007)	Service (Hotel)	Turkey	N/A	PQ, BI, and BL	N/A	(Aaker, 1991; Keller, 1993)
[53] (Herrmann *et al.*, 2007)	Service (Insurance Company)	Germany	Marketing Mix	Cognitive, Emotional, and Conative Focus	N/A	(Keller, 1993; Yoo *et al.*, 2000)
[46] (Gil *et al.*, 2007)	Consumer Goods (Milk, Olive Oil, and Toothpaste)	Spain	Advertising, Family, Price, and Promotions	BA, BAs, PQ, and BL	OBE	(Yoo *et al.*, 2000)
[70] (Konecnik and Gartner, 2007)	Destination	Slovenia	N/A	BA, BI, PQ, and BL	N/A	(Aaker, 1991; Keller, 1993)
[85] (Mohd *et al.*, 2007)	Consumer Goods (Air-Conditioner)	Malaysia	Country of Origin Image, Brand Distinctiveness, BA/Bas, and BL	OBE	N/A	(Yoo *et al.*, 2000)
[38] (Davis *et al.*, 2008)	B2B Service (Logistics)	USA	BA and BI	OBE	N/A	(Keller, 1993)
[2008] (Chen & Chang, 2008)	Service (Airline)	Taiwan	N/A	BA/BAs, BL, and PQ	Brand Preference, Purchase Intent	(Cobb-Walgren *et al.*, 1995)
[68] (Kim et al., 2008)	Service (Hospital)	Korea	Customer Satisfaction, Relationship Commitment, BA, BL, and BT	OBE	BI	(Berry, 2000; Pappu *et al.*, 2006)

[73] (Lee & Back, 2008)	Conference Attendee	Hong Kong	N/A	BAs, BSat, BV, and BT	N/A	(Keller, 1993)
[26] (Chang and Liu, 2009)	Service Industry	China	Brand Attitude and BI	BA/BAs, PQ, and BL	Brand Preference, Purchase Intent	(Faircloth *et al.*, 2001)
[22] (Broyles *et al.*, 2009)	Coca-Cola and KFC	USA	Reliability, Effectiveness, Awareness, Behavioural Loyalty, Attitude	PQ, Perceived performance, Resonance, and Imagery	Future Purchase Intent	(Aaker, 1991; Keller, 1993)
[122] (Wang et al., 2009)	Service (Banks and Departmental Stores)	Taiwan	Service Staff, Servicescape, Customer Similarity, Customer Interaction, and Relationship Quality	BL and BAs	N/A	(Berry, 2000)
[20] (Boo *et al.*, 2009)	Destination	USA	N/A	BA, BI, PQ, BV, and BL	N/A	(Aaker, 1991)
[9] (Atilgan *et al.*, 2009)	McDonald and Coca Cola	USA, Turkey, and Russia	N/A	BAs, PQ, BT, and BL	N/A	(Aaker, 1991)
[117] (Tong and Hawley, 2009)	Consumer Goods (Sportswear)	China	BAs, BL, PQ, and BA	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[27] (Chattopadhyay *et al.*, 2010)	Consumer Goods (Automobile)	India	Media Mix Elements	PQ and BA	OBE	(Yoo *et al.*, 2000)
[24] (Chahal and Bala, 2010)	Service (Hospital)	India	Attitudinal Loyalty	Excellent Performance and Improved Performance	Behavioural Loyalty	(Krishnan & Hartline, 2001)
[69] (Kimpakorn and Tocquer, 2010)	Service (Luxury Hotels)	Thailand	N/A	BA, PQ, BAs, BT, Brand Relationships, and Brand differentiation	N/A	(Aaker, 1991; Berry, 2000)
[52] (He and Li, 2011)	Telecommunication Service	Taiwan	Perceived Service Quality and Perceived Value	OBE	N/A	(Washburn *et al.*, 2004)
[105] (Rios and Riquelme, 2010)	Online Companies	Australia	Customer Service, Fulfilment, and Functionality	Awareness, Loyalty, Trust Associations, and Value Associations	N/A	(Aaker, 1991; Keller, 1993)
[90] (Nam *et al.*, 2011)	Service (Hotel and Restaurants)	England	N/A	Lifestyle Congruence, Staff Behaviour, Physical Quality, Self Congruence, and Brand Identification	BL	(Aaker, 1991)
[17] (Bian and Liu, 2011)	Service (Hotel)	China	N/A	BA, BAs, PQ, BL, and BV	Customer's Intent	(Aaker, 1991)
[66] (Kim & Hyun, 2011)	IT Software	Korea	Marketing Mix	Corporate Image, BA/Bas, PQ, and BL	OBE	(Yoo *et al.*, 2000)
[49] (Ha, 2011)	Service Industry	Korea	Marketing Mix	BSat, PQ, BA/BAs, and BL	OBE	(Yoo *et al.*, 2000)
[30] (Chen et al., 2011)	Industrial Goods (Fasteners)	Taiwan	Perceived Product and Service Quality, Country of Origin, BA, and BL	OBE	N/A	(Yoo *et al.*, 2000)

[95] (Nyadzayo *et al.*, 2011)	B2B Marketing (Franchisee Channels)	Australia and New Zealand	Brand Relationship Management and Brand Citizenship Behaviour	Franchisee Perceived Relationship Value, BI, and BL	N/A	(Aaker, 1991)
[87] (Mourad *et al.*, 2011)	Service (Higher Education)	Egypt	N/A	BA attributes and BI attributes	OBE	(Keller, 1993)
[55] (Hyun and Kim, 2011)	Service (Chain Restaurants)	Korea	N/A	BA, BI, PQ, and BL	N/A	(Aaker, 1991)
[18] (Biedenbach *et al.*, 2011)	B2B Service (Logistics)	Sweden	Role Ambiguity, Rapport, and Rapport	BA, BAs, and BL	N/A	(Aaker, 1991)
[116] (Teck Ming *et al.*, 2012)	Service Shops	Malaysia	N/A	BA, BL, BI, and PQ	N/A	(Aaker, 1991)
[100] (Pinar *et al.*, 2012)	Service (Bank)	Turkey	N/A	BA, PQ, BI, BL, BAs, and Organizational Association	N/A	(Aaker, 1991)
[25] (Chahal and Bala, 2012)	Service (Healthcare)	India	PQ, BL, and BI	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[126] (White *et al.*, 2013)	Retail Service	USA	Service Quality and E-Service Quality	Retailer's Brand Equity (OBE)	N/A	(Yoo *et al.*, 2000)
[56] (Jahanzeb *et al.*, 2013)	Service (Bank)	Pakistan	Service Quality, Corporate Credibility, and Perceived Value	OBE	N/A	(Yoo *et al.*, 2000)
[123] (Wang & Finn, 2013)	Consumer Goods (Soft Drink)	Canada	N/A	Past BL, BA, BAs, PQ, Perceived Value of Cost, Uniqueness, and Brand Emotions	Future BL and Future Price Premium	(Aaker, 1991; Keller, 1993)
[23] (Buil *et al.*, 2013)	Consumer Goods (Sportswear, Car, and Electronics)	UK and Spain	BA, BAs, PQ, and BL	OBE	Purchase Intention, Preference, Premium, and Extension	(Aaker, 1991; Yoo *et al.*, 2000)
[83] (Mishra, 2014)	Consumer Goods (Smartphone)	India	Intrinsic and Extrinsic Consumption Value	BAs, BV, PQ, and BT	OBE	(Aaker, 1991; Yoo *et al.*, 2000)
[74] (Lee et al., 2014)	Port	Korea	BA, PQ, and BL	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[32] (Christodoulides *et al.*, 2015)	Goods, Service, and Internet Brands	UK, Germany, and Greece	N/A	BL BA, PQ, and BAs	N/A	(Aaker, 1991)
[112] (Sinčić Ćorić and Jelić, 2015)	B2B Chemical Market	South and Eastern Europe	N/A	Salience, Performance, Imagery, Judgements, Feelings, and Resonance	N/A	(Keller, 2003)
[60] (Kao and Lin, 2016)	Service (Bank)	Taiwan	PQ, BT, BSat, and BL	OBE	N/A	(Yoo *et al.*, 2000)
[93] (Nørskov *et al.*, 2015)	Consumer Goods (Digital Audio Mp3 Player)	Denmark	Product Innovation Attribute	BA, BAs, PQ, and BL	N/A	(Aaker, 1991)
[82] (Mills and Williams, 2016)	Campus Recreational Sports	USA	Advertising, Past Experience and WOM	OBE	BL	(Ross, 2006)
[84] (Mohan and Sequeira, 2016)	Consumer Goods (FMCG)	India	BA, BAs, PQ, and BL	OBE	Operational Performance	(Baldauf *et al.*, 2003)

[89] (Mukherjee and Shivani, 2016)	Service (Bank)	India	Marketing Mix	User BI, Corporate Bi, Service BI, and PQ	N/A	(Aaker, 1991; Keller, 1993)
[108] (Sharma, 2016)	Luxury Product	India	Celebrity Endorsement	BAs, BL PQ, and BA	N/A	(Aaker, 1991)
[51] (Hanaysha, 2016b)	Consumer Goods (Automobile)	Malaysia	Service Quality	BA, PQ, BAs, and BL	N/A	(Aaker, 1991)
[113] (Singh and Pattanayak, 2016)	Service (Fast Food Chains)	India	N/A	BA, BL, BAs, and PQ,	N/A	(Aaker, 1991)
[8] (Arora and Neha, 2016)	Service (Bank)	India	N/A	Brand Investment, Salience, Performance, Verdict, Unfamiliarity, and Feelings	N/A	(Aaker, 1991; Keller, 1993)
[106] (Rodrigues and Martins, 2016))	Retail Clothing Chain	Portugal	BA, PQ, and Brand Personality	OBE	Brand Loyalty and Price Premium	(Keller, 2003; Netemeyer *et al.*, 2004)
[164] (Khan and Khan, 2017)	Consumer Goods (Fashion Apparel)	India	BA, PQ, BAs, and BL	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[109] (Sharma, 2017)	Consumer Goods (Smartphone)	India	BA, BL, BAs, and PQ	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)
[75] Liu *et al.*, 2017)	Service (Hotel)	China	N/A	BA, PQ, BL, and BI	Purchase Intent	(Aaker, 1991; Cobb-Walgren *et al.*, 1995)
[102] (Rambocas *et al.*, 2018)	Service (Bank)	Trinidad and Tobago	N/A	OBE	Repeat Purchase, Switch, Price Premium, and WOM	(Buil *et al.*, 2013)
[91] (Narteh, 2018)	Service (Bank)	Ghana	N/A	BA, BAs, PQ, BL, and Relevance	Brand Performance	(Aaker, 1991)
[44] (Filieri *et al.*, 2019)	Consumer Good (Smartphone)	China	Country of Brand Origin and Brand Popularity	BA, PQ, BL and Brand Mianzi	Purchase Intentions and OBE	(Aaker, 1991; Cobb-Walgren *et al.*, 1995)
[114] (Sinha and Verma, 2018)	Consumer Goods (FMCG)	India	Sales Promotion	BA, BAs, PQ, and BL	N/A	(Aaker, 1991)
[103] Raut *et al.*, 2019)	Consumer Goods (Cell Phone)	India	BA, BI, Brand Judgement, Brand Performance, and Brand Feelings	BSat and BT	BL, Brand Attachment, Brand community, and Brand Engagement	(Keller, 2003)
[110] (Sharma and Jain, 2019)	Consumer Goods (Sportswear)	India	Perceived CSR, BT, and BL	OBE	N/A	(Yoo *et al.*, 2000)
[57] (Jayswal and Vora, 2019)	Advergames	India	BAs	OBE	N/A	(Yoo *et al.*, 2000)
[40] (Ebrahim, 2020)	Service (Telecommunication)	Egypt	Social Media Marketing Activities	OBE	BL	(Yoo *et al.*, 2000)
[58] (Joseph *et al.*, 2020)	Consumer Good (Hair Shampoo)	India	BL, Sales Promotion	OBE	N/A	(Yoo *et al.*, 2000)
[120] (Verma, 2021)	Consumer Good (Smartphone)	India	Brand Love and Brand Engagement	OBE	Purchase Intention	(Yoo *et al.*, 2000)
[59] (Kalhor *et al.*, 2021)	Service (Hospital)	Iran	BA, BAs, PQ, BL, BT and BSat,	OBE	N/A	(Aaker, 1991; Yoo *et al.*, 2000)

"BA-Brand Awareness, BAs-Brand Association, PQ-Perceived Quality, BL-Brand Loyalty, BT-Brand Trust, BI-Brand Image, BV-Brand Value, BSat-Band Satisfaction, OBE-Overall Brand Equity, WOM-Word of Mouth, CSR-Corporate Social Responsibility and N/A-Not Applicable"

Table 1: Summary of selected CBBE frameworks

3. CONCEPTUAL ISSUES CONCERNING CBBE

3.1 *Are the relevant factors for CBBE better considered as its components or antecedents?*

Some authors (Bian & Liu, 2011; Biedenbach et al., 2011; Boo et al., 2009; Broyles et al., 2009; Pappu et al., 2005) [17, 18, 20, 22, 97] consider brand equity a second-order reflective construct composed of multiple dimensions. The premise that these elements are often operationalized in a range of ways, each susceptible to criticism, is one of the primary downsides of this composition approach. Integrating these variables into a composite action merely adds another layer of (debatable) sophistication (Mackay *et al.*, 1998) [79]. Nobody knows how these components should be combined to capture brand equity (Gill and Dawra, 2010) [47]. In contrast, other authors (Atilgan et al., 2005; Buil et al., 2013; Chen & Myagmarsuren, 2011; Davis et al., 2008; Ebrahim, 2020) [10, 23, 30, 38, 40] treat the brand equity construct as unidimensional and the associated factors as antecedents. Wang and Finn (2013) [123] adopted a different approach and considered brand equity a formative construct. It's not apparent whether these various facets are drivers or outcomes of the underpinning brand equity notion. Based on our findings and literature assessment, brand equity elements should be deemed precursors of brand equity, resulting in brand loyalty. As Dabholkar *et al.* (2000) [36] have already shown, such an approach enables a more robust understanding of the changing "service quality" construct. Simply addressing related elements as precursors to brand equity is logical in advancing the construct (Wang et al., 2006) [124]. This transition delivers the direct impact of preceding constructs on the solitary brand equity construct. The antecedent paradigm would offer more insights into how customers perceive brand equity and how this perspective influences their behavior (Wang et al., 2006) [124].

3.2 *What role does "brand loyalty" play in conceptualizing brand equity?*

According to Morgan (1999) [86], "equity" and "loyalty" are the two most exploited buzzwords in the English marketing language, and both are employed in branding. The idea of brand equity cannot be explored without touching on brand loyalty, as it is identified as the heart of brand equity (Aaker, 1991; Kim et al., 2008) [1, 68]. The linkage connecting loyalty and equity is a bit fuzzy. While Aaker (1991) [1] asserted loyalty is the fundamental element of brand equity, Keller (1993) [62] contends that loyalty is the product of brand equity instead of its driver. So, Keller's position on brand loyalty contradicts Aaker's. Further, Nam *et al.* (2011) [90] backed Keller's stance by pointing out that brand equity is perceptual, while loyalty is a behavioral term tied to repurchase intentions. Brady *et al.* (2008) [21] distinguish loyalty from equity, emphasizing that equity encompasses brand image as well as brand familiarity. Traditionally, brand loyalty has been used to describe repurchase intentions. On the other hand, brand equity denotes a favorable attitude that may or may not lead to purchase behavior. As a result, rather than being a component of brand equity, behavioral intentions are one of its outcomes. Mahajan *et al.* (1994) [78] also suggested that brand equity only reflects perceptual aspects, not behavioral factors like loyalty. Previous research showed that brand equity leads to consumers' repurchase intentions, favourable WOM, ready to pay the extra price, recommendations to others, and customers retention (Broyles et al., 2009; Buil et al., 2013; Chahal & Bala, 2010; Chang & Liu, 2009; Chen & Chang, 2008; Cobb-Walgren et al., 1995; Filieri et al., 2019; Rambocas et al., 2018; Rodrigues & Martins, 2016; van Riel et al., 2005; Wang & Finn, 2013) [22, 23, 24, 26, 29, 34, 44, 102, 104, 106, 123]. This integration of the Theory of Planned Behavior (TPB) from (Ajzen, 1991) [6] and CBBE is vital because high brand equity can boost customers' positive brand evaluation, affecting behavioral intention (Wu *et al.*, 2020) [128].

3.3 *Do brand equity factors related to consumer goods also apply to service brands and B2B marketing?*

A substantial body of evidence reinforces the notion that branding is essential for B2B goods marketers. Brand equity encourages B2B consumers to pay a higher price to contemplate brand promotions and extensions (Bendixen *et al.*, 2004; Michell *et al.*, 2001) [14, 81]. According to these findings, brand equity produces the same beneficial results in the B2B environment as in the B2C. However, some scholars have claimed that branding has a modest influence in the B2B context because the number of traders is indeed small; thus, gathering information is much easier (Anderson *et al.*, 2009) [7]. The transaction in the B2B marketplace is likewise thought to have a better reasonable grounding considering experienced experts in different disciplines are engaged in dealing (Kim & Hyun, 2011) [66].

According to Berry (2000) [15], branding is not simply for material goods; it is crucial for service businesses. Bharadwaj *et al.* (1993) [16] underlined that marketing is far more critical for services over

products due to buyers' difficulty purchasing services. Furthermore, the intangibility of services and the irreconcilability of consumption and production necessitate a unique strategy for building a successful service brand. Few authors proposed methods to develop a strong brand in the service sector (Berry, 2000; Krishnan & Hartline, 2001) [15, 71]. The logic for branding services and goods is analogous. The emphasis is on establishing and using brand equity to cultivate customer rapport. Mackay (2001) [77] posits that several of the well-established CBBE criteria employed in the consumer goods industry can also assess brand equity in the services market.

Previous studies on CBBE (see Table1) indicated that many researchers (Berry, 2000; Bian & Liu, 2011; Biedenbach et al., 2011; Chen & Chang, 2008; Davis et al., 2008; Herrmann et al., 2007; Hyun & Kim, 2011) [15, 17, 18, 29, 38, 53,55] adopted Aaker (1991) [1] or Keller (1993) [62] model as a base for measuring consumer-based brand equity in different contexts such as Luxury Hotels, Chain Restaurants, Airline, Hospital, Telecommunication, Financial Institutions, Insurance Company, Industrial Goods (Fasteners and Chemicals) and even for B2B Service Branding (Logistics). Grace and O'Cass (2002) [48] suggested that brand characteristics may vary among goods and services, with some perceived as exclusive to a particular industry while others are ubiquitous. In addition, practical applications by numerous renowned international consulting firms (Young & Rubicam, A.C. Nielson, Interbrand) do not discriminate between services and goods when evaluating brand equity (Bamert and Wehrli, 2005) [12]. It's apparent from the literature (see Table 1) that some facets of the seminal works (Aaker, 1991; Keller, 1993) [1, 62], which were primarily focused on consumer goods, may also be applied to service brands and B2B marketing.

4. DEVELOPING A CROSS-CONTEXTUAL COMPREHENSIVE FRAMEWORK

Existing CBBE research demonstrates a level of consistency in respect of factors. Nevertheless, there are certain contradictions and overlaps in the linkages among significant elements and some variations in model structuring. Understanding and evaluating brand equity are complicated tasks. Scholars have spent a lot of time identifying the variables that can capture and assess brand equity. In general, there is little unanimity about the brand equity dimensionality. Our study begins with reviewing the existing literature on CBBE. Against the perplexing backdrop of diverse meanings and conceptualizations of brand equity and despite the diversity of voices concerning the structure of brand equity, authors discovered that the most widely recognized dimensions in various situations are Brand Image *(BI)*, Brand Awareness *(BA)*, and Perceived Quality *(PQ)*; afterward, authors placed a separate unidimensional brand equity *(BE)* construct (see figure 1), as it reflects the value of brand name, and this notion can be low or high (Farquhar, 1988; Yoo and Donthu, 2001) [43, 129].

Some studies employ complicated methodologies to evaluate brand equity, such as lengthy series of questions or conjoint analysis (Park and Srinivasan, 1994) [99]. However, Agarwal and Rao (1996) [3] discovered that sophisticated questions might not be required to achieve valid brand equity estimates. Alternatively, advocated for a more straightforward approach based on a single item brand equity assessment. The brand equity *(BE)* construct fundamentally manifests a brand name's power to distinguish the associated product from a non-branded product (Yoo and Donthu, 2001) [129].

The researcher transited the observed key denominators as the antecedents of brand equity. This shift from components to antecedents would assist in understanding how various factors affect brand equity (Wang et al., 2006) [124]. As loyalty in purchasing is the ultimate goal of all branding activity over time, we positioned brand loyalty as the result of the brand equity construct instead of a component or antecedent of brand equity (*see Figure 1*). This framework is a fusion of the direct and indirect measurement approach of brand equity and is believed to suit better how customers evaluate brand equity.

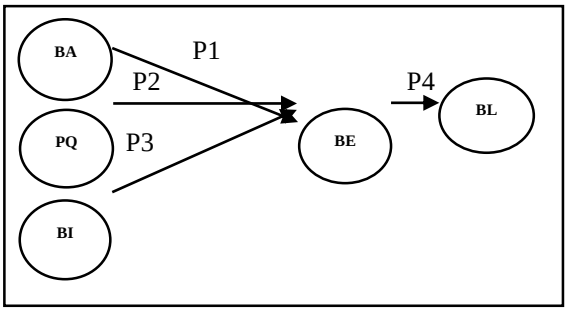

Figure 1: Conceptual Model

The suggested model comprises three critical aspects of analysis: antecedents of brand equity, brand equity in itself, and the outcome of brand equity.

4.1 *Antecedents of Brand Equity*

4.1.1 ***Brand Awareness (BA)***

Aaker (1991) [1] described brand awareness as "the ability of the prospective buyer to identify and recollect that a brand is a part of a specific product category." As a concept, awareness is crucial since, without it, brand equity would be diminished or nearly non-existent (Keller, 2003) [63]. Being aware is imagined to build value for the brand by forming

a basis associated with specific traits. Thus, creating excellent brand awareness becomes necessary to draw consumers' attention. Previous research (see Table 1) reveals that brand awareness is fundamental to practically every CBBE framework.

P1. *BA has a positive effect on BE.*

4.1.2 *Perceived Quality (PQ)*

Zeithaml (1988) [131] defined perceived quality as "the customer's perception of a product or service's overall quality or superiority about its intended purpose relative to alternatives." Perceived quality can be deconstructed into product and service quality when the core offering amalgamates tangibles and service (Teck Ming *et al.*, 2012) [116]. It's important to note that consumers' perception of the goods and services matters, not the actual quality. As evident from Table 1, quality is the "core" feature throughout the CBBE frameworks.

P2. *PQ has a positive effect on BE.*

4.1.3 *Brand Image (BI*

According to Keller (1993) [62], brand image is "perceptions about a brand as reflected by the brand association preserved in consumer memory" and identified three elements for brand image: qualities, benefits, and attitudes. It is users' overall cognitive impression of a brand and its uniqueness concerning its competitors (Faircloth *et al.*, 2001) [42]. Every interaction between a firm and customers in the services industry contributes to brand image, and brand image is likewise significant in the B2B market.

P3. *BI has a positive effect on BE.*

4.2 *Brand Equity (BE)*

The topic of brand equity is rich in definitions, theories, and measuring methodologies. In essence, the notion that brands provide value to goods is called brand equity. Agarwal and Rao (1996) [3] stressed that there is no need to utilize sophisticated procedures to quantify CBBE. A basic approach employing single-item measures such as "willingness to pay premium" (Netemeyer *et al.*, 2004) [92] or even using a specific item such as "even if another brand has the same features as X, I would like to buy X" performs the job (Yoo *et al.*, 2000) [130]. This straightforward process can be inexpensive in capturing brand equity's essence (added value).

4.3 *Outcome of Brand Equity*

Oliver (1997) [96] characterized loyalty as "a deeply held commitment to rebuy or (re)patronize a preferred product/service consistently in the future, thereby causing repetitive same-brand, or same-brand set, purchasing despite situational influences and marketing efforts having the potential to cause switching behaviour." *Brand Loyalty (BL)* is regarded as the heart of brand equity (Aaker, 1991) [1], and it's a well-established fact that loyalty is highly relevant in B2C and B2B marketing (Biedenbach *et al.*, 2011) [18]. So, practically every researcher adopted this essential construct in their CBBE framework.

P4. *BE has a positive effect on BL*

An exhaustive and in-depth literature review helped construct a cross-contextual CBBE model. The study reveals that factors essential to brand equity (*BA, BI, and PQ*) may be tailored to numerous brand types and varied economic sectors. However, these factors should be seen as antecedents of brand equity, not quite as brand equity components. Another crucial feature of the suggested structure that deserved emphasis was brand loyalty, as loyalty must be considered a possible result of brand equity instead of merely a component.

5. THEORETICAL CONTRIBUTIONS

Brand equity is the soul of branding, yet it is also at a crossroads. Mainstream marketing theories and operations have acknowledged that brand equity is crucial for every organization. Academic debate is equivocal about the theoretical roots of brand equity. The benefaction of this work to the marketing literature is dual; first, the authors examined the fundamental conceptual issues of CBBE. Second, the study investigated the existing CBBE models and proposed a cross-contextual model that can be deployed in multiple settings, leading to more sophisticated models. The suggested framework is expected to have substantial practical significance for marketing managers and scholars investigating consumer brand equity.

Eventually, a pursuit of the unified theory of branding is desired (Davcik *et al.*, 2015) [37]. The present work will considerably contribute to this unified branding theory. It presents a preliminary foray into conceiving a cross-contextual framework CBBE. This study is among the first to suggest a CBBE framework adaptable to numerous brand types and varied economic sectors. Brand equity facets (*BA, BI, and PQ*) are conceived as antecedents of customers' brand equity overall evaluation in the proposed framework. In other words, brand equity is handled as a unique construct rather than a composite of factors; this decompositional strategy is a logical progression of the construct and will provide even more helpful information to both academics and managers.

Brand equity theory has been explored for over four decades, and brand loyalty has been deemed the

heart of brand equity (Aaker, 1991) [1]. However, the function of this heart-shaped loyalty in the brand equity framework is still unresolved. This research supports the integration of brand equity theory with the Theory of Planned Behavior (TPB) from (Ajzen, 1991) [6]. Strong brand equity can strengthen consumers' positive brand evaluation, driving repurchase behavior. As loyalty in purchasing is the ultimate goal of all branding efforts, it's regarded as a result of brand equity.

In essence, the framework offered here provides a conceptual paradigm for grasping how brand equity can be managed cross-contextually. This framework varies from conventional brand equity conceptualizations that focus on a compositional approach and emphasize the importance of the decomposition approach. In determining the antecedents of brand equity, the researcher focuses extensively on factors applicable in different settings. While acknowledging this initial version is drawn from existing literature, it acts as a possible launching pad for the empirical inquiry that may progress to far more advanced brand equity frameworks and provide an improved understanding of the phenomena and its intricate relationships.

6. LIMITATIONS AND FUTURE RESEARCH

The present study acknowledges a few shortcomings that may inspire exciting possibilities for future investigation. Our research proposed only a direct relationship between antecedents and brand equity construct; future studies should explore the mediation effect of factors (e.g., brand satisfaction) in the relationship between antecedents and brand equity. Scholars can further study the causal link among brand equity antecedents.

Potential researchers should also incorporate other variables to build a more holistic model, for instance, brand mianzi or brand love. In addition, our proposed model featured only brand loyalty as the significant outcome; researchers can also include other effects such as recommendations, switching, or word of mouth. We only picked brand equity frameworks based on consumer viewpoints; future work should encompass research based on employee perspectives or integrate financial-based equity with consumer perspectives. Given the constraints, this research can act as a base for a more profound knowledge of brand equity and fill the gaps in the dialogue about developing a cross-contextual CBBE framework.

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INFLUENCING FACTORS OF WILLINGNESS TO BUY COUNTRY-OF-ORIGIN BRANDS POST COVID-19 PANDEMIC: AN EMPIRICAL STUDY

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Abstract. *The Corona virus-19 pandemic disrupted the lifestyle and purchasing habits of customers, which also has a harmful effect on the global economy. The GDP of a nation is significantly influenced by consumer purchases of domestically produced goods and nation's own brands, which also aid in the recovery of the nation's economy. The objective of the paper is to study the variables that affect decisions of consumers' purchasing and to model those variables with structural equation modeling to find the causal relationship. Factors like consumer ethnocentrism, economic nationalism and Attitude towards foreign-brands (ATFB) were evaluated to examine significant impact on willingness to buy country-of-origin brands (WBCOB) and products. The data was collected from 450 students of Sardar Patel University using convenient sampling with structured questionnaires using established scales. CFA and SEM using SPSS AMOS were applied to analyse the data. The findings show that he COVID-19 pandemic has driven customers to motivate economic nationalism by purchasing Indian brands that supports the buying of Indian-made goods and encouraging others to do the same will positively affect and strengthen the Indian economy. This study shows that students' ATFB, such as rejecting foreign brands and endorsing Indian made products, has a favourable impact on purchasing patterns for goods made in India, reflects ethnocentrism, and demonstrates economic nationalism among Indians. It was determined that ATFB mediates the significant effect of consumer ethnocentrism on the WBCOB. This finding can assist marketing specialists to articulate an effective promotion strategy to encourage ethnocentric tendencies, and they can give consumers clues to encourage feelings of economic nationalism when they purchase products or services.*

Keywords: *Consumer ethnocentrism, economic nationalism, attitude towards foreign brand, willingness to buy country-of-origin brands*

1. INTRODUCTION

The coronavirus outburst was declared a "pandemic" by World Health Organization on 11th March, 2020 [1]. Indian people faced undiscovered circumstances during the initial stage of the lockdown, which caused a historically unprecedented shift in consumer preferences. There was no need for lifestyle products, and things were divided into two groups namely basic and non-basic goods. Only necessary products were provided to people [2].

People from all over the world expressed their feelings against China because they thought that China did not take necessary preventive actions to stop the epidemic spread. This was another unusual behaviour that was observed. Additionally, China was reopening its enterprises while India and other nations were compelled to implement lockdown, which had a negative impact on country's economy. Several nations around the world showed signs of nationalism. People began discussing the value of independence and decreasing reliance on China, which is regarded as the world's production center. The world appears to have started moving away from globalisation toward localized products and services even before this pandemic [3]. Chinese government always adhered to the China First policy; similarly, the USA with America First policy caused other nations to begin turning internal and strengthening their economies which resulted into giving surge to nation-first policy. Noticeable variations in the type of products purchased, the location of purchases, and the usage of digital payments, particularly in developing nations like India, were witnessed amid the nationwide lockdown [4]. Therefore, it is essential to understand new consumer behaviour and novel marketing tactics in the post COVID-19 period and key elements affecting consumers when they buy post lockdown.

This study makes an effort to answer to questions based on two significant developments that occurred during the lockdown: The first sign of the economy's negative impact was the complete halt of economic activity. Therefore, it is important to research how the public feels about the economy and who they believe should be involved in its recovery. Second, if the economic effects were to occur, would customers still make impulsive buying or would they start making more deliberate decisions? Would consumers' ethnocentric behaviour lead them to be more willingness to buy the country-of-origin brands (WBCOB)?

2. LITERATURE REVIEW

It was noted through updates from various regions of the world that people began thanking medical professionals and neighborhood grocery or provision shops for supplying them with necessities

for existence. The actions of the people revealed a sense of nationalism. The review of literature includes economic nationalism (EN), consumer ethnocentrism (CE), attitude towards foreign brands (ATFB), and willingness to buy country-of-origin brands (WBCOB).

2.1. Consumer Ethnocentrism (CE)

Sharma et al., [5] considered consumer ethnocentrism as an idea that is based on three perspectives: first, consumer anxiety about the economy damaging of his or her own nation by purchasing foreign brands; second, the ethics of purchasing imported goods and third, a personal bias towards imports. Consequently, customers with ethnocentrism have confidence in that foreign brands are not patriotic, harm the domestic economy and results in employment losses. Conversely, people who are not ethnocentric evaluate foreign brands depending on without taking into account where such things are from in made [6]. Baughn & Yaprak, [7] and Shimp & Sharma, [8] found that the consumers have positive and favourable attitude towards domestic or local brands while [9] stated in his study that other consumers have a positive attitude towards foreign brands. Shimp and Sharma [10] developed consumer ethnocentrism into measured construct through the use of consumer ethnocentrism tendencies scale (CETSCALE) with 17-item which is commonly and globally accepted. Consumers who liked domestic brands over foreign brands, the CETSCALE with 6-item was formed by Klein et al. [11].

2.2. Economic Nationalism (EN)

Economic nationalism can be considered as a 'Country first' stance and adopts a collective sentiment of prejudice over foreign brands. It is influenced by identity of nation, ethnocentrism and consumer nationalism [12]. People with nationalism started consuming nationalised goods and dressing in style goods that feature symbols or colours of nation; choose TV programmes with national flavour and favour purchasing locally made products [13]. Additionally, consumers closely look into the country-of-origin signs on the "Made in" or "Brand Origin" labels on packaging depending on their economic nationalism while making purchases disposition and attitude that is ethnocentric and economic nationalism [14]. Economic and socio-psychological factors are important when customers behave favourably in favour of domestic brands [15][16].

3. THE MODEL/CONCEPTUAL MODEL

Many studies have been conducted on Consumer nationalism and consumer ethnocentrism before pandemic. Few studies focused on influencing factors for WBCOB but not in India. Only a handful studies were conducted on consumer willingness to buy Indian brands in which data was collected during the pandemic. Therefore an attempt is made to examine the crucial elements which affect consumer willingness to buy Indian brands post Covid-19 pandemic. Observations and literature indicate that because of the pandemic, consumers are keen to support the efforts put in by govt. to revive the economy of the nation and pay attention to "made in India" or "Indian origin" products while buying.

The study focuses on assessing customers' willingness to buy country-of- origin brands, which is influenced by ethnocentrism (indicating a choice or liking for domestic brands which is originated from home nation). The idea of economic nationalism will help boosting country's economy post pandemic. With this insight, theoretical framework was prepared by Verma and Naveen, [17] which was partially used by researcher in this study (Fig. 1). This frame also comprises the impact of attitude towards foreign brands on WBCOB after pandemic.

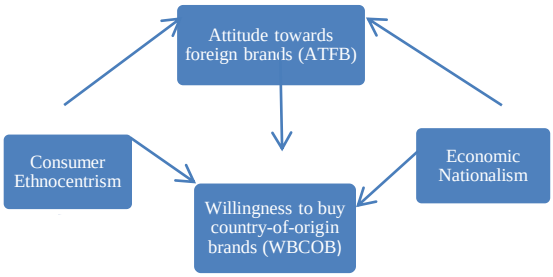


Fig.1. Frame work for WBCOB

The main objective of the study is to determine whether the compulsion to stay at home as a result of the COVID-19 crisis has affected consumer buying behavior and to detect the elements that would influence decisions of consumers after lockdown, post economic activity resumption. The sub-objectives are as follow:

- To understand the consumer buying behaviour post Covid-19 situation
- To study the factors affecting consumer willingness to buy country-of-origin brands post Covid-19 pandemic

- To measure the impact of each influencing factors on willingness to buy country-of-origin brands post lockdown

Based on the available literature and objectives of the study, following hypothesis can be formulated:

H1: CE has a significant effect on WBCOB.

H2: ATFB affects WBCOB.

H3: EN has a significant influence on WBCOB.

4. METHODOLOGY

This research study is descriptive in nature. The data is gathered by using structured questionnaire. The questionnaire comprises of five components. First component is for demographic profile of respondents, second section is for consumer ethnocentrism, third for economic nationalism, next components on attitude towards foreign brands and last section is on WBCOB. A Likert scale with 5 point was used to get responses for all the influencing factors and WBCOB through structured questionnaire.

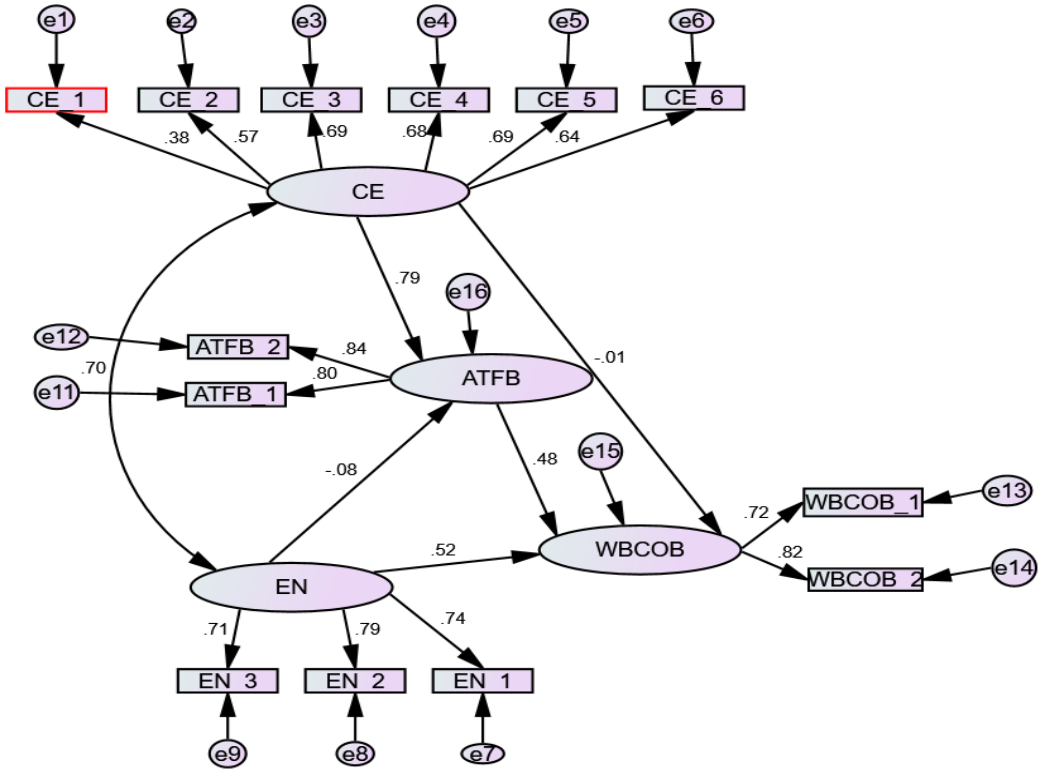
A non-probability convenience sampling was used to collect the data from the students of Sardar Patel University covering UG, PG and PhD courses with 450 respondents. Structural equation modelling (SEM) which is regarded as being suitable for analysing complex cause-and-effect relationships is used for analysis [18]. The measurement model covers influencing factors namely consumer ethnocentrism, economic nationalism; as "exogenous variables". The WBCOB is an "endogenous variable". The ATFB is taken as a mediating variable between exogenous variables and WBCOB. Mediation analysis is done to determine an indirect effect as the "mediating" variable, ATFB, on the relationship between the influencing factors as two exogenous variables and the endogenous variable (WBCOB).

Data Analysis

Out of 450 respondents, 63.3% were male and 36.7% students were female. The majority 62% students were in UG course, 34.2% in PG course and only 3.8% from PhD course. 61.8% students were having annual family income below Rs.2 lakhs and 18.7% students were having annual family income between Rs.2 to Rs.5 lakhs. In case of residing status of students 56% students are urban and 42% rural.

SEM Analysis

Fig.2. shows SEM measurement model with influencing factors like CE, EN as exogenous variables and WBCOB as endogenous variable. The



factors of ATFB were depicted as mediating variable between influencing variables and WBCOB. Fig. 2. shows the impact of exogenous and mediating variables on endogenous variable.

Construct	Cronbach's alpha	Composite Reliability	AVE	Square root of AVE
CE	0.770	0.586	0.381	0.617
EN	0.786	0.676	0.555	0.745
ATFB	0.800	0.729	0.667	0.817
WBCOB	0.745	0.640	0.598	0.773

Note: AVE- Average variance extracted

Table.1. Determining Reliability and Validity Scale

Table 1 shows that the Cronbach's alpha for all the items is >0.7, which shows the acceptance level of scale. The composite reliability of all the latent variables were near to 0.7 except in case of consumer ethnocentrism which showed the internal consistence of constructs (Hair et al., 2006). The value of AVE for all constructs were >0.5 except in case of CE, which establish the convergent validity. The values of square root of AVE of all latent constructs were higher than inter correlation of measured variables therefore; the discriminant validity was also established.

Model Fit

Goodness of Fit Measures	$\chi 2$/df	GFI	NFI	CFI	TLI	RMSEA
Measurement Model	6.218	.862	.840	.860	.788	.108
Structure Model	3.687	.929	.907	.929	.891	.077
Criterion (threshold values)	<5.0	>.90	>.90	>.90	>.90	<.08

Note: $\chi 2$/d=Relative Chi-square; GFI=Goodness of Fit Index; NFI=Normed fixed index; CFI=Comparative fit index; TLI=Tucker-Lewis Index; RMSEA=Root mean squared error of approximation;

Table 2. Goodness of fit measures

Above Table-2 depicts the measures of goodness of fit for structural model. Correlation between CE and EN has increased the model fitness to satisfactory level. All the goodness of fit measures are within the given threshold values. Thus it is finally determined that the given created structural model is a valid and right instrument.

Regression Path			Estimate	S.E.	C.R.	*P* value	Hypothesis
EN	→	ATFB	-0.066	0.11	-0.598	0.55	Not supported
CE	→	ATFB	1.227	0.166	7.401	***	supported
EN	→	WBCOB	0.575	0.088	6.539	***	supported
ATFB	→	WBCOB	0.382	0.067	5.72	***	supported
CE	→	WBCOB	-0.033	0.134	-0.25	0.803	Not supported

*Note: ***P<.01*

Table 3. SEM Assessment

Table 3 depicts the relationship between exogenous, mediating and endogenous variables. Economic nationalism does not have impact on ATFB as per *p* value is >.05. Also, CE does not influence the WBCOB as its *p* value is .803. Remaining exogenous variable EN and mediating variable ATFB have impact on WBCOB in case university students as their *p* values are <.01. Factors loadings (Figure 2) clearly shows that consumer ethnocentrism has negligible impact (-.01) on WBCOB but has significant impact (.79) on ATFB. Economic nationalism has also negligible influence (.08) on ATFB but significant impact (.52) on WBCOB. Attitude towards has significant impact (.48) on WBCOB.

	Standardised Estimates				
	EN→ATFB	CE→ATFB	EN→WBCOB	CE→WBCOB	ATFB→WBCOB
Total Effects (*P* value)	-.085 (.415)	.786 (.001*)	.482 (.001*)	.368 (.001*)	.480 (.001*)
Direct Effects (*P* value)	-.08 (.431)	.786 (.002*)	.523 (.001*)	-.009 (.888)	.480 (.001*)
Indirect Effects (*P* value)	-	-	-.040 (.411)	.377 (.001*)	-

Source: own research, *Note:* * 5% significant level

Table 4. Mediation Analysis

Table 4 states the mediation analysis through standardized total, direct and indirect effects of latent variables. In case of consumer ethnocentrism having conclusive impact on ATFB and WBCOB based on p value <.001. Economic nationalism is not having significant effect on ATFB (p > .005) but solid direct significant effect to WBCOB (p <.001). Thus, ATFB is playing a mediating role in case on CE but not with EN in impacting WBCOB.

5. RESULTS & DISCUSSION

According to the findings of the study, pandemic has driven consumers to motivate economic nationalism by purchasing Indian brands. When consumers feel a sense of nationalism, they begin to consume nationalised items. These results are in line with [18] study. Additionally, they believe that supporting the buying of domestic brands and encouraging others to do the same will positively affect and reinvigorate the Indian economy. This study shows that students' ATFB, such as rejecting foreign brands and endorsing Indian made products, has a favourable impact on purchasing patterns for goods made in India, reflects ethnocentrism, and demonstrates economic nationalism among Indians. It was determined that ATFB mediates the impact of consumer ethnocentrism on the WBCOB. This shows that students are keen to purchase Indian-made brands when they have negative attitudes regarding foreign brands. Surprisingly, Castelló and Mihelj (2018) and Mishra and Naveen (2021) found that the impact of economic nationalism on WBCOB mediated by ATFB. In the present study, impact of EN on WBCOB is not mediated by ATFB. Besides, consumers' shopping habits before pandemic spread do not affect their purchases of domestic brands in the post-pandemic period, suggesting that the buying behaviour would be different and those consumers might be more likely to buy brands that would help the country to recover its economy.

6. CONCLUSIONS

The COVID-19 epidemic has presented the world with previously unheard-of issues and changed how people live. Most nations imposed a lockdown in order to stop the virus' spread, which resulted into joblessness, insecurity, and an economic depression. Countries began to consider domestic production of goods and services as a way to lessen their reliance on foreign nations. India started supporting the domestic production and purchasing of products and services produced in India, showing that it is not an exception. This had a significant impact on how people behaved when making purchases. The current study comes to the conclusion that there is an increased WBCOB and that the lockdown caused by pandemic has ignited sense of economic nationalism among people of India and the pandemic-related ATFB was the main factor in this.

7. MANAGERIAL IMPLICATIONS

The Findings of this study can help marketing personnel to frame an effective promotion strategy to encourage ethnocentric tendencies, and they can give consumers clues to evoke feelings of economic nationalism when they buy goods or services. The results will be helpful to both managers of domestic brands and marketing managers of foreign brands in sustaining and maintaining their marker share.

8. LIMITATIONS AND FUTURE SCOPE

This study was conducted with the students of university and revealed the buying behaviour of students. Therefore, given results cannot be generalized for the entire population and for entire nation. The same study can be conducted with more diverse sample from entire nation and also with different consumers from different countries. Similar study can be done in future with more influencing factors to measure the tangible change in buying pattern.

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MAPPING THE WORLD OF DIGITAL ENTREPRENEURSHIP: A BIBLIOMETRIC ANALYSIS OF 21 YEARS (2001-2022)

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Abstract. *In digital entrepreneurship, bibliometric analysis and mapping have yet to be utilized to evaluate production and depict the industry's progress and trends. As a result, the primary objective of this research is to conduct a bibliometric analysis of digital entrepreneurship in the Scopus Collection. Between 2001 and 2022, 198 papers were published in 135 journals by 489 authors from 253 institutions and 48 nations. The publication history of the works was examined by looking at when they were published, where they were published, and what journals published them. A three-field plot analysis of authors, citations, and nationalities was also carried out, as did a thematic analysis. Eventually, suggestions for further studies are provided, with repercussions for policymakers and scholars.*

Keywords: *Biblioshiny, Digitalization, Bibliometric Review, Online ventures, Digital Entrepreneurship*

1.INTRODUCTION

Entrepreneurship research has mainly aimed to clarify the factors contributing to the inherent uncertainty of starting a business and the conditions in which entrepreneurial behaviour emerges in the face of this uncertainty (Nambisan, 2017). Indeed, uncertainty "*serves as the conceptual cornerstone for most entrepreneur theories*" (McMullen and Shepherd, 2014). The incorporation of new digital technologies, like cloud computing, mobile computing, 3D printing, data analytics, and social media into diverse aspects of business has changed the degree of unpredictability in venture creation procedures and structures, along with the methods for coping with this kind of unpredictability, in recent years. This has led to a plethora of relevant research topics at the convergence of digitalization and entrepreneurship - on digital entrepreneurship - which necessitate a detailed examination of digital technologies and their particular attributes in influencing business ventures.

The fast advancement of digital technology has contributed substantially to the global economy's structural shifts. Deconstructing conventional methods of conducting business over the previous few decades, digital technology has ushered in a new era of innovation in corporate strategies, processes, goods, and services. The widespread adoption of digital technologies has generated far-reaching implications for business owners in the modern era. Companies based on digital technologies consequently represent the majority of today's economic value creation. Apple, Microsoft, Amazon, and Alphabet were four digital technology businesses in the top five by market cap in 2021. In essence, these businesses are built on digital platforms. Due to the widespread adoption of information technology, the business world is no longer bound by brick-and-mortar locations or regional economies, leading to the emergence of Digital Entrepreneurship. Digital entrepreneurship covers "the intersection of digital technology and entrepreneurship." Businesses whose foundation is creating value via the exchange of electronic information through mobile networks are the primary target of this strategy. (Nambisan, 2017). One definition of digital entrepreneurship is the search for business prospects via digital media.

At the same time, another describes the commercialization of products and services conducted on digital mediums, most often the Internet. Kollmann, 2006 states that "E-entrepreneurship refers to establishing a new company with an innovative business idea within the net economy, which, using an electronic platform in data networks, offers its products and services based upon a purely electronic creation of value. Essential is the fact that this value offer was only made possible through "*the development of information technology*," while Hull et al., 2007 have defined it as "a *subcategory of entrepreneurship in which some or all of what would be physical in a traditional organization has been digitized*."

Growth in digital technology has dramatically affected the dynamics of entrepreneurship and the results it produces. This has altered how entrepreneurship is conducted in practice. Consequently, research on digitalization and digitization in entrepreneurship and management has been promoted and expanded. By reviewing the articles available on Scopus, one of the most critical worldwide databases, to comprehend this topic's nature, this field study offers a comprehensive overview of the digital entrepreneurship field. Academicians utilize different qualitative and quantitative literature review methods to comprehend and analyze prior studies. Among them, bibliometrics can offer a comprehensive,

transparent, and verifiable evaluation process using the statistical measurement of academia. Pritchard initially used the word "bibliometrics" in 1969. The statistical examination of the comparative anatomy literature from 1543 to 1860, which included grouping book and journal titles by countries of origin and periods, is an early example of bibliometric research (Tella and Aisha Olabooye, 2014). Researchers typically derive their conclusions from compiled bibliographic information from other researchers who articulate their opinions through writing, cooperation, and citation using bibliometric tools. When the information is gathered and evaluated, insights into the field's architecture, academic interests, and social networks can be gained.

Additionally, the bibliometric approach is assumed to be advantageous to more conventional methods of analysis (like thematic reviews and SLRs) for gaining essential insights into how research has evolved and progressed, as well as the significant issues that have influenced research in a particular field of study. It relies on objective methodology to derive qualitative insights (Chawla and Goyal, 2022). Rather than merely providing a static perspective, this research aims to derive observations from the year-over-year development of digital entrepreneurship-related literature. These sorts of studies are deemed most appropriate for bibliometric analysis. Therefore, the bibliometric analysis and its related tools have been used for this study to extract insights from published publications in the Digital Entrepreneurship area during the past 21 years.

2. MATERIAL AND METHODS

2.1 Data Collection

Bibliometrics operates on data derived from a couple of major literature databases, Scopus and Web of Science (Aria and Cuccurullo, 2017). We considered the online Scopus database to collect articles published on digital entrepreneurship from the year 2001 to the year 2022. The Scopus database was chosen for this investigation since it is one of the most prominent regulated article and citation collections and has significant international coverage of books, esteemed journals, and conference proceedings. (Baas *et al.*, 2020). Details of author and institution profiles and comprehensive metadata records for scientific papers are provided by Scopus. Advanced algorithms and manual curation, wherever required, assure accuracy in profiling.

The reliability attached to Scopus makes it a preferable source of data for research assessments, landscape studies, institution rankings, and evaluation of policies (Baas *et al.*, 2020). When doing the bibliometric analysis, it is essential to choose the appropriate keywords. We utilized the following query terms based on the study's objectives – Digital, Entrepreneurship, Virtual, E-commerce, Internet, and E-entrepreneurship. Therefore, we mentioned this query in the article title field for figuring out papers: TITLE [("*Digital Entrepreneurship*") OR ("*Internet Entrepreneurship*") OR ("*E-entrepreneurship*") OR ("*E-commerce entrepreneurship")* OR ("*Virtual Entrepreneurship*")]. Finally, 198 papers were received and chosen for further evaluation using the Bibliometric approach. The bibliometric analysis is conducted using the Biblioshiny application to achieve the study's objectives.

2.2 Data Analysis

The productivity of one subset of entrepreneurship, digital entrepreneurship, was examined through a quantitative and qualitative bibliometric study. Indicators such as authorship, country studies, and top journal rankings bring attention to these developing patterns in the research landscape. The connection between authors, keywords, and citations was also examined through co-occurrence analysis. After a more thorough search, the results were exported to CSV or excel file with the following fields: authors, year published, publication's name, abstracts, subject category, ISSN, keywords, and times cited. The collected information then needed to be cleaned. The Data was analyzed for possible similarities or discrepancies, and the author names were normalized. Additionally, descriptive approaches, bibliometric analysis, and bibliometric mapping were used to examine the outcomes. There were two stages to the analysis. It began by calculating the fundamental bibliometric indices (number of articles produced annually by language, country, institution, journal, and author). Then it moved on to analyzing co-keywords, co-authors, co-citations, and terms in titles and abstracts.

3. RESULTS

3.1 Basic Bibliometric Indicators

3.1.1 Primary information and Chronological evaluation of articles published-

This section analyses the research profile of Digital Entrepreneurship, encompassing published sources from 2001 to 2022. It encompasses information regarding the current level of publications, most cited articles, research trends, established contributors, nations, universities, authors' keywords, and publication sources. 2001 marked the appearance of the earliest article on Digital Entrepreneurship in the Scopus database. The information in Table 1 pertains to all papers published in Digital Entrepreneurship from 2001 to 2022 and includes average publishing years, document-wise average citations, year-wise average citations, document classifications and elements, authors' information, and collaboration work by authors.

Table 1. Overview of results

Particulars	Information about Particulars
Basic Information	
Time-period of Study	2001:2022
Number of Sources	135
Number of articles	198
Annual Percentage Change	19.34
Average Age of Document	3.64
Document-wise Average citations	19.67
Number of References	11056
Types of Documents included	
Papers published in conferences	50
Other Papers	148
Contents used in Documents	
Indexed Keywords	672
Keywords provided by Authors	640
Information about Authors	
Total Number of Authors	489
Number of Authors in single-authored documents	35
Collaboration by Authors	
Documents with a Single Author	37
Number of Co-Authors/ document	2.81
Percentage of International co-authorships	23.74

Source: Author's compilation

Figure 1 depicts a historical projection of digital entrepreneurship-related publications from 2001 to 2022, year by year. During 2001-2012, the notion of digital entrepreneurship was in its infancy, and research was in its infancy. This may be due to the fact that industries were adopting and establishing digital platform solutions like the Internet at this time. In addition, the company's central emphasis was on business process transformation using conventional IT approaches, although other early-mover organizations experimented with new technology. In 2012, digital entrepreneurship studies began to gain momentum. The number of papers published each year remained constant during this time. Since 2018, the number of articles has grown dramatically, maybe because firms began embracing operations facilitated by digital technology, and studies on digital entrepreneurship gained more consideration. Since then, the number of publications has increased year after year. The year 2022 saw the most extensive number of publications, and research in the digital entrepreneurship field has accelerated significantly. Since 2018, this number of articles can be linked to the increasing number of publications on digital entrepreneurship. Considering the current trend and rate of papers produced, it is reasonable to forecast that future years will produce more articles. This research field's steady expansion indicates that the phenomenon has become a prominent area of investigation across academicians.

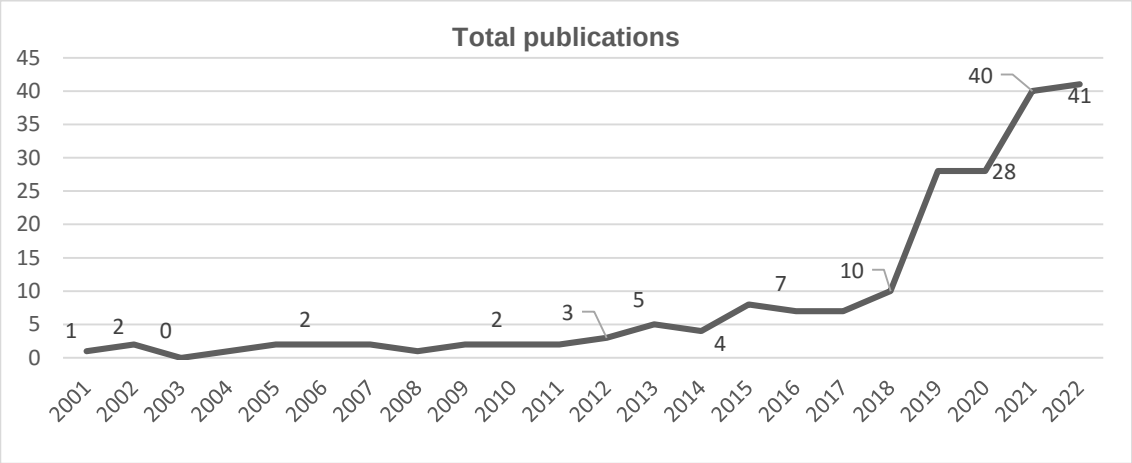


Fig. 1. Chronological evaluation of articles published

Table 2 shows the highest-ranked publications from our original sample of 198 articles, according to their Scopus database citations. However, 44 of the 198 papers have never been mentioned, whereas 94 have between one and ten citations. Table 2 contains a list of top-ten articles with the highest citations. The table enlists the articles in descending order according to the magnitude of citations. With 729 citations, "*Digital Entrepreneurship: Towards a Digital Technology Perspective on Entrepreneur-ship*" (Nambisan, 2017), tops the list with the highest number of references. In this paper, the writers emphasized the cause – and - effect relationship between the latest technologies in the IT space on the one hand and the inherent uncertainty in entrepreneurial outcomes as well as processes on the other hand. This work is a front-runner regarding the number of citations in the research arena on Digital entrepreneurship. The article with the second-most citations, "*Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process*" by Elia et al., 2020, describes the digital entrepreneurship ecosystem by emphasizing "*the integrated digital output and digital-environment*

perspectives." Considering the current trend and rate of papers produced, it is reasonable to forecast that future years will produce more articles. This research field's steady expansion indicates that this has emerged as a hot potato among academicians. Prior studies, such as "*Internet entrepreneurship: Social capital, human capital, and performance of Internet ventures in China*," "*Virtual Teams and the Rise of e-Entrepreneurship in Europe*," etc., focused primarily on the emergence of Digital Entrepreneurship. In post-2015 research, many study streams have emerged, such as Model innovation in digital entrepreneurship and digital entrepreneurship system. In a nutshell, we witness a shift from a more generalized and nascent stage to more specialized research streams.

Table 2. Top ten highly cited articles on Digital Entrepreneurship

Paper	Author	Total Citations	Citations Per Year
"Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship"	Nambisan, (2017)	729	121.5
"Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process"	Elia et al., (2020)	200	66.67
"Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches"	Ghezzi & Cavallo, (2020)	199	66.33
"Internet entrepreneurship: Social capital, human capital, and performance of Internet ventures in China"	Batjargal, (2007)	181	11.31
"Digital entrepreneurship: Innovative business models for the sharing economy"	Richter et al., (2017)	137	22.83
"Virtual Teams and the Rise of e-Entrepreneurship in Europe"	Matlay & Westhead, (2005)	124	6.89
"Taking advantage of digital opportunities: a typology of digital entrepreneurship"	Hull et al., (2007)	121	7.56
"Digital Entrepreneurship and Its Socio-material Enactment"	Davidson & Vaast, (2010)	118	9.38
"Digital entrepreneurship: An interdisciplinary structured literature review and research agenda"	Zaheer et al., (2019)	84	21.00
"What is e-entrepreneurship? – fundamentals of company founding in the net economy"	Kollmann, (2006)	75	4.41

Source: Author's compilation

This survey included 198 papers from 135 journals. Table 3 presents a thorough analysis of journals according to their citations. The effect of the most prolific journal is shown by the number of publications and citations of that particular journal (Dzikowski, 2018). For ease of use, the top 10 journals having at least two published papers are listed in detail. Sustainability (Switzerland) has the most publications, with a total of 11, according to data from Table 3 below. The Journals "Technological forecasting and social change" and "Frontiers in Psychology" are addressed after this. Table 3 provides a thorough overview of the journals' production over time, total number of citations, G-index, M-index, and H-index, respectively.

Table 3. Top ten journals on Digital Entrepreneurship

Journals	Total Documents	Total Citations	G-Index	M-Index	H-Index
"Sustainability" (Switzerland)	11	120	10	0.857	6
"Technological Forecasting and Social Change"	8	479	8	2	8
"Frontiers in Psychology"	6	7	2	1	2
"Procedia Computer Science"	5	41	5	0.375	3
"International Journal of E-entrepreneurship and Innovation"	4	13	3	0.750	3
"Information Systems Journal"	3	104	3	0.750	3
"International Journal of Entrepreneurial Behaviour and Research"	3	58	3	0.667	2
"International Journal of Management Education"	3	4	2	0.500	1
"Journal of Business Research"	3	290	3	0.600	3
"Journal of Small business and Enterprise Development"	3	160	3	0.158	3

Source: Author's compilation

Table 4 includes the ten most prolific writers, along with their total number of papers published, citations they received, and their h-index, m-index, and g-index. The effect of the most productive author is

determined by the number of publications and citations obtained. According to Table 4, Krauss S., Li Z., and Matley H. have produced four publications on digital entrepreneurship, making them three of the most prolific authors in the field. Following this, there are three articles each by Cavallo A, Dwivedi YK, and Ghezzi A. Cavallo A and Ghezzi A received the highest citations (294).

Table 4. Top ten influential authors on Digital Entrepreneurship

Authors	Total Papers	Number of Citations	H-Index	M-Index	G-Index
Kraus S	4	242	3	0.375	4
Li Z	4	56	2	0.143	2
Mataly H	4	232	4	0.211	4
Cavallo A	3	294	3	0.75	3
Dwivedi YK	3	22	2	2	3
Ghezzi A	3	294	3	0.75	3
Leong C	3	36	3	0.429	3
Tan B	3	24	2	0.286	3
Abubakre M	2	26	2	1	2
Bican PM	2	86	2	0.667	2

Source: Author's compilation

The list of nations according to the volume of published research on digital entrepreneurship is included in Table 5. The most productive and contributing nations (Table 5) in the study fields of digital entrepreneurship are determined by the magnitude of papers produced by each nation and their mean number of citations. Out of 48 nations, only 15 have published more than ten articles. The United States is shown to be the most productive and helpful nation based on the overall number of citations received. China leads all countries in productivity with 92 articles, followed by the United States and the United Kingdom. Evidently, the nations that have contributed the most to research articles on digital entrepreneurship are the United States of America, the United Kingdom, China, India, Germany, and Australia. Similarly, by Utilizing Biblioshiny, the researchers identified the most productive institution. The number of papers produced by the most prolific affiliations or institutions is depicted in Table 6. The highest ten affiliations are included in the graph for simplicity.

Table 5. Top 10 Institutions in the field of Digital Entrepreneurship

Most influential Institutions	Total Articles Published
National Changhua University of London	7
Czestochowa University of Technology	6
Graz University of Technology	6
Via Lambruschini	6
Jingdezhen Ceramic Institute	5
Universiti Teknologi MARA	5
University of Ghana Business School	5
Arab University College of Technology	4
E.Philip Saunders College of Business	4
Jilin University	4

Source: Author's compilation

Table 6 demonstrates that the National Changhua University of London is the most influential in debating and publishing topics relevant to Digital Entrepreneurship, with seven publications.

Table 6. Top 20 in Digital Entrepreneurship

Country	Documents Published	Total Citations	Average Article Citation
USA	49	1490	93.13
UK	34	371	41.22
Italy	14	296	74.00
Germany	29	257	28.56
Australia	20	144	28.80
China	92	126	5.04
France	19	62	15.50
Finland	3	54	54.00
Sweden	12	51	25.50
Netherlands	6	49	24.50
Ireland	6	42	21.00
Portugal	12	38	12.67
Poland	7	36	9.00
Saudi Arabia	9	28	4.67
India	23	15	3.75
Denmark	7	13	6.50
Qatar	4	13	13.00
Austria	9	12	6.00
Korea	1	11	11.00
Canada	9	10	10.00

Source: Author's compilation

An analysis was conducted for the most frequent words in the bibliometric study on Digital Entrepreneurship. Table 7 below displays the analysis's most frequent terms and a list of keywords. The top authors and indexed keywords that occur more than five times are displayed in the table below. Figures 2 and 3 display the word cloud based on authors' and Indexed keywords. Word cloud based on authors' keywords includes: Entrepreneurship, E-commerce,E-entrepreneurship, Digital Transformation, Digital Technology,

Digitalization, Digital Entrepreneurship, Innovation, and Education. In contrast, the word cloud of the indexed keywords for Digital entrepreneurship includes Digital Entrepreneurship, Entrepreneur, Electronic Commerce, Information Systems, Innovation, Entrepreneurship, Digital Technologies, Information Use, Students, Digitization, Internet Entrepreneurship, and Sustainability.

Source: Biblioshiny
Fig. 2. Word cloud of Indexed Keywords

Table 7. Top indexed keywords (1) and author's keywords (2) that occur five or more times

(1) Indexed Keywords	Occurrences
Digital Entrepreneurship	25
Entrepreneur	17
Electronic Commerce	16
Information Systems	14
Innovation	14
Entrepreneurship	12
Digital Technologies	11
Information Use	10
Students	10
Digitization	8
Internet Entrepreneurship	8
Sustainability	8

(1) Indexed Keywords	Occurrences
Entrepreneurship education	7
Internet	7
Commerce	6
Ecosystems	6
Information Technology	6
Social Networking online	6
Sustainable Development	6
Technological Forecasting	6
Virtual Reality	5
E-learning	5
Economic & Social Effects	5
Economics Social Media	5

(2) Author's Keywords	Occurrences
Digital Entrepreneurship	94
Entrepreneurship	31
E-commerce	15
E-entrepreneurship	14
Digital Transformation	8
China	7
Covid-19	7
Digital	7
Digital Technology	7

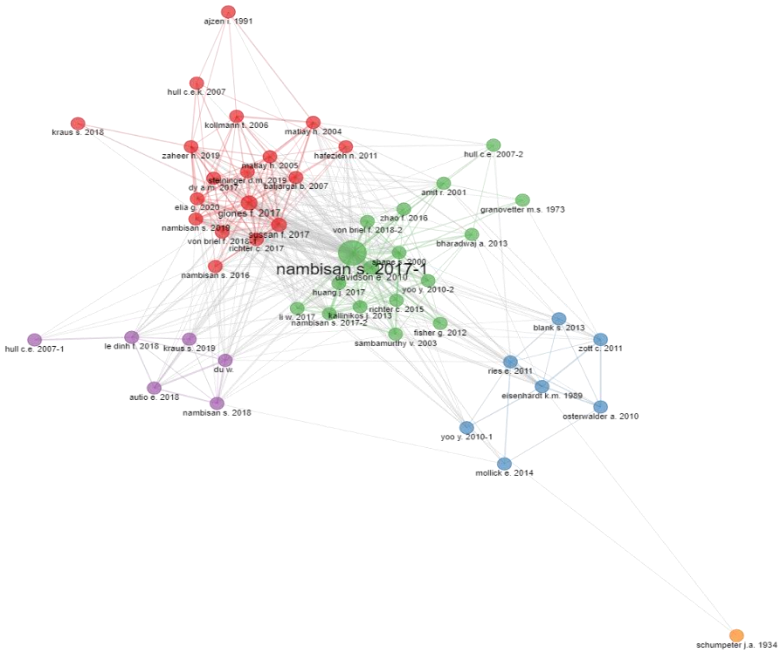
(2) Author's Keywords	Occurrences
Digitalization	7
Entrepreneurship Education	7
Innovation	7
E-business	6
Social Media	6
Case Study	5
Cyber Entrepreneurship	5
Internet Entrepreneurship	5

Source: Biblioshiny

Source: Biblioshiny
Fig. 3. Word cloud based on Authors' Keywords

3.1.2 Co-citation analysis

Research methods based on bibliometric networks such as co-citation analysis, are essential for comprehensively assessing the Digital Entrepreneurship literature and its significance in developing ideas. This analysis shows how the articles' popularity and accessibility have evolved (Zhu *et al.*, 2021). The overall number of citations indicates a document's prominence in a particular field of study, whereas citation frequency analysis focuses on how often other works have referenced a document. Contrarily, co-citation analysis reveals connections between cited and referenced works. When three different works reference the same two sources, this is called a co-citation (Aria and Cuccurullo, 2017). As noted by Measure (1973), the co-citation analysis looks at the connections between things like authors, journals, titles, and keywords to see how closely connected things are. In Figure 4, we have a representation of the co-citation network between papers in the field of Digital Entrepreneurship. Clusters 1 and 3 contain many papers and are represented by the colours red and green, respectively. Cluster 2 is displayed in blue, whereas Cluster 4 is shown in purple. It has been observed that research communities arise when multiple writers mention the same sets of two publications. Clusters of papers with similar citation patterns often share a common theme. The figure displays the co-citation networks within the dataset, dividing them into four distinct groups. A node with a similar colour appears to share certain commonalities. This linkage diagram illustrates the organizational principles underlying the authors' citations in this study on digital entrepreneurship. The key works on this topic are shown in Table 3, forming a co-citation network.

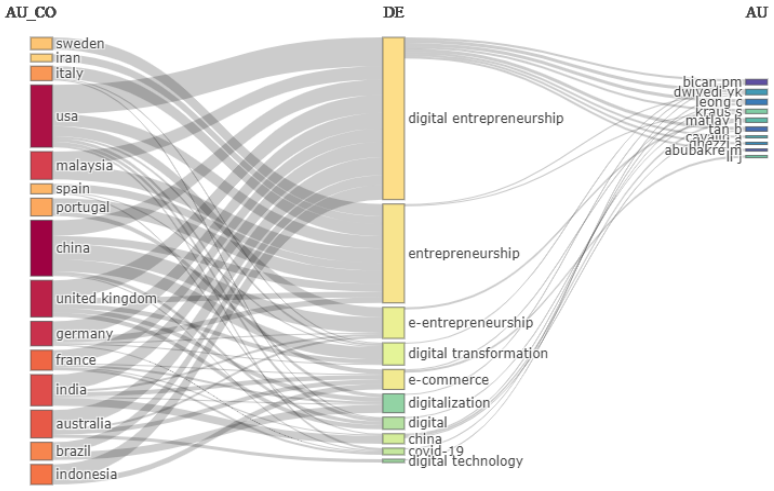


Source: Biblioshiny
Fig. 4. Co-citation Analysis

3.1.3 Three-field plot

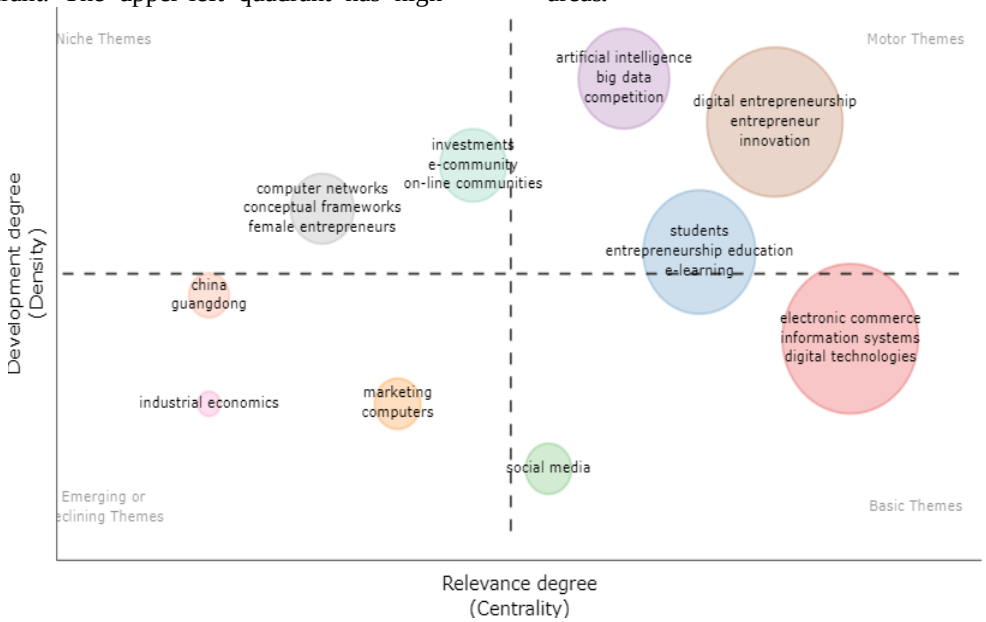
Figure 5 depicts the three-field layout for nations, keywords, and authors. This diagram is based on the more common Sankey designs (Riehmann, Handler and Froehlich, 2005). According to Riehmann et al. (2005), the size of the boxes is associated with the number of occurrences. Hence it can be stated that the United States has the highest number of publications on the stated research theme, and its scholars publish more on "*digital entrepreneur-*

ship," "*e-entrepreneurship*," "*entrepreneurship*," and "*digitalization*." "*Digital entrepreneurship*" is also the primary focus of researchers in each country shown in the graph. The terms "*digital entrepreneur rship*," and "*e-commerce*" are popular among Indians and the top ten authors listed in the graph. Most of the authors' work centres on "*digital entrepreneurship*," while other plot-related keywords receive less attention.



Source: Biblioshiny
Fig. 5. Three-Field Plot

Figure 6 depicts the thematic progression of Digital Entrepreneurship based on the authors' keywords. This analysis, in particular, enables the reader to transmit knowledge on a specific issue, in this instance, Digital Entrepreneurship. Figure 6 depicts the motor themes in the upper-right quadrant. They are distinguished by their high density and centrality, regarded as the most evolved issue in the literature and the primary research subject in digital entrepreneurship study. Digital Entrepreneurship, Artificial Intelligence, E-learning, innovation, competition, students, and entrepreneurship education are the driving themes in this quadrant. The upper-left quadrant has high-density topics but minor external linkages, making it of little importance in the field (low centrality). This quadrant's topics include online communities, investment, computer networks, conceptual frameworks, and female entrepreneurs. The developing or fading themes are located in the lower-left quadrant. This area includes marketing, computers, China, Guangdong, and industrial economics in digital entrepreneurship research. Finally, the primary and transversal themes are shown in the lower-right quadrant. This quadrant contains electronic commerce, information systems, digital technology, and social media. These themes address broad issues across the field's many study areas**.**



Source: Biblioshiny
Fig. 6. Thematic Evolution

4. DISCUSSIONS AND IMPLICATIONS

This research paper conducted a detailed assessment of the literature on Digital entrepreneurship for over 21 years to reflect the current research situation. Using bibliometric analytic approaches, we assessed the effectiveness of authors, published journals, affiliated universities, and nations. To understand the broader domain of digital entrepreneurship, we conducted citation, keyword analysis, and co-citation.

The year-by-year historical examination of articles identifies two stages, the first until 2012 as its infancy, and the second, after 2018 onwards, with an international expansion. The analysis determined the most influential and contributing writers by analyzing the volume of papers published and the total citations obtained by each author.

The most cited article is "Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship" by Satish Nambisan, followed by "Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process" by Elia.

Parida, Krauss S., Li Z., and Matley H. have the most publications, each with four. Cavallo A and Ghezzi A have the most citations, with a total citation document score of 294 each. The evaluation of citations reveals a strong correlation between the highest cited publications and the most prominent authors. “Technological Forecasting and Social Change” is the most-referenced journal.

The National Changhua University of London, Czestochowa University of Technology, and the Graz University of Technology are the institutions that have contributed the most. The research also looked at the countries that contributed the most in terms of papers produced and total citations. China has the most published articles, followed by the United States of America and Germany. Co-citation analysis shows that the work of Nambisan, Sussan, and Giones is the most referenced; these writers serve as the foundation for future study. According to co-word analysis, the most general keywords in the literature on Digital entrepreneurship are Digital entrepreneurship, Entrepreneurship, E-commerce, and E-entrepreneurship. This research study aimed to organize and rationalize the published flow of digital entrepreneurship-related knowledge. We have assessed and analyzed the underlying framework of the digital entrepreneurship literature to guarantee that the objectives of this research study have been met.

We shall now go over the study's repercussions. The findings have significant educational and administrative repercussions. In terms of conceptual contributions, the research adds to the current information base by analyzing the advancement of research in digital entrepreneurship. It develops and summarizes information on notable writers, associated organizations, locational matrices of the writers, contributing journals, and important keywords that have substantially shaped the study of Digital entrepreneurship through citation and co-citation analysis. In addition, the findings extensively identify the research clusters and developing research streams that, when other digital technologies and their applications emerge, the research studies may be expanded to enhance the Digital entrepreneurship literature. Another contribution of this study is bibliometric and network analysis concepts, which academicians can use to acquire information on critical topics and develop research trends in other sectors of significance. For the professional world, our study gives pertinent information into the present state of research, future central projections, and various schools of thought, allowing them to outline key emphasis areas and highlight key concentration areas for a smooth transition to a technology-driven business. In a nutshell, this study will serve as a quick reference guide for professionals, providing them with accurate data and actionable advice to maximize the rewards of their digital entrepreneurial activities.

5. CONSTRICTIONS & FUTURE OUTLOOK FOR RESEARCH

The research study is restricted to a single source (Scopus) for information retrieval, and the conclusions are derived from these publications. Despite being the most comprehensive source, it only reflects a portion of the total articles. Similarly, we retrieved articles based on specified keywords. Different results may be obtained by modifying the search indexes, databases, keywords, or disciplines. There is a lot of diversity in the domain of digital entrepreneurship; thus, there might be a lot of differences in the keywords. Therefore, findings should be generalized consciously. Furthermore, the citation analysis is centred on quantity rather than quality. Overall, we see a rise in digital entrepreneurship initiatives in reality, and we recommend additional research to provide case-based practical insights for digital entrepreneurship clients and implementation partners. As a result, we advise that future research include comprehensive perspectives rather than limiting them to single areas. We also propose developing a generally recognized quantitative metric to evaluate the impact of digitalization in the commercial sector, which has yet to be addressed in the literature on digital entrepreneurship. Finally, we propose expanding this study by undertaking quantitative studies to provide more statistically quantifiable findings, utilizing this or other indexes such as Google Scholar or Web of Science Collection.

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