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No. 28/1 Primrose Road, (Off M.G. Road), Bangalore - 560025.

bri@sjim.edu.in | www.sjim.edu.in

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Editor's Note

Dear Readers,

It gives me great pleasure to present the December 2025 issue of the Journal *Business Review*, the annual peer-reviewed publication of St. Joseph's Institute of Management, Bangalore. This volume brings together a diverse collection of research papers that embody the intellectual curiosity, academic rigor, and interdisciplinary ethos that define our institution. Each contribution offers fresh insights into contemporary issues in management, technology, sustainability, and society, collectively enriching our understanding of the rapidly evolving landscape of business and human behavior.

The opening article, 'Mediational Mechanisms of Mindful Consumption: A Conceptual Analysis' by Jose Mathews is a conceptual paper that offers a nuanced exploration of the psychological processes that underpin mindful consumption. By distinguishing between mindful mindsets and mindful behaviours, and situating the discussion within cognitive, emotional, motivational, and personality frameworks, the author provides a deeper understanding of how individuals can engage with consumption more consciously—supporting both personal well-being and sustainability.

In article 'Exploring the Product-as-a-Service (PaaS) Circular Business Model: Opportunities and Challenges' by Rizwana Khanum, Davita Sananda, and Jhanavi N examine the transition from ownership-based business models to service-oriented frameworks grounded in sustainability. Through a multidisciplinary review of literature and industry experiences, the paper highlights how PaaS can enhance product longevity, improve resource efficiency, and deepen customer engagement. At the same time, it draws attention to the operational, technological, and organizational challenges that firms must address when adopting circular business systems.

The final paper in this volume, 'Examining the Role of Privacy Policies in Online Personal Information Sharing' by Fatin, Joyce Petricia B, and Neha U, investigates how users interpret privacy policies and how these perceptions affect their willingness to share personal information online. Drawing on survey findings, the study uncovers

a significant gap between users' trust in privacy disclosures and their actual understanding of them. The authors highlight key factors—including policy clarity, transparency, and data-protection awareness—that influence online behavior in today's increasingly data-driven digital environment.

The paper titled 'Management Through Trust Building — A New Journey Ahead' by Tridib Chakrabortti presents an insightful reflection on the pivotal role of trust in interpersonal and organizational relationships. Drawing upon psychological principles and contemporary workplace challenges, the author underscores that trust is built through consistent communication, fairness, support, and professional credibility. As society becomes increasingly complex and digitally mediated, the paper reminds us that cultivating trust remains essential for meaningful collaboration and effective management.

The article 'Intersection of Digital Advertising and Promotion of Sustainable Development Goals in India: A Study' by Niharika Nayak and Santosh Kumar Biswal explores the expanding role of digital advertising as a catalyst for social change. Employing discourse analysis, the authors examine how digital campaigns in India promote themes such as health, gender equality, environmental protection, and social justice. Their study underscores the growing responsibility of brands, governments, and NGOs to align communication strategies with the Sustainable Development Goals, thereby shaping public attitudes and influencing behaviour.

Another manuscript titled 'Predicting Stock Prices Using Neural Networks in the Energy Sector' by Satarupa Misra and Shreyas P, investigates the application of neural networks to forecast stock prices of energy companies using key macroeconomic indicators. Drawing on ten years of sectoral data, the authors demonstrate how non-linear models can uncover complex patterns that traditional forecasting methods often fail to detect. Their findings highlight the promise of artificial intelligence in supporting investment decisions within highly volatile markets, while also acknowledging the challenges posed by stock-specific fluctuations.

In 'Sustainable Sustenance: Reimagining Bundelkhand's Cuisine for Cultural Preservation and Environmental Resilience', Shivansu Sachan and Mridulesh Singh delve into the rich culinary heritage of Bundelkhand and its significance for sustainable

development. The paper illustrates how traditional food systems—rooted in millets, non-timber forest products, and climate-resilient agricultural practices—can enhance food security, empower local communities, and preserve cultural identity. By interweaving historical context, case studies, and developmental perspectives, the authors present Bundelkhand's cuisine as a compelling model for environmentally conscious and culturally grounded growth.

Together, these papers showcase the breadth and depth of contemporary research across business, society, and technology. I extend my sincere appreciation to all the authors for their valuable contributions and to the reviewers for their insightful evaluations. I am confident that this edition of the Business Review will stimulate thought and make a meaningful contribution to our readers' knowledge. The ideas presented here underscore the significance of interdisciplinary research in fostering innovative, ethical, and sustainable approaches to the future of business and society.

Dr. Deepika Joshi

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Table of Content

Mediational Mechanisms of Mindful Consumption: A Conceptual Analysis

Mr. Jose Mathews[1]

Abstract

The two core attributes of mindful consumption, as suggested in the basic model are a mindful mindset and mindful behaviour. The objective of this conceptual paper is to elaborate on the construct of mindfulness (and mindset) that differentially influences consumption. Drawing on the extant literature, the construct of consumption is delineated into mindful and mindless wherein the intra-individual psychological processes shape the consumption pattern. Elaborating on the core attributes of mindfulness, mindful mindset and mindful behaviour, the dynamics of consumption are explored in the light of behavioural theories that apply to it. The explanatory power of the intra-individual variables cognition, affect, motivation and personality processes are explored in this paper.

Keywords: Mindful consumption, Cognition, Motivation, Emotion, Personality

1. Introduction

Mindful consumption is proposed as an alternative to normal consumption, overconsumption, or mindless consumption to underline the importance of customer-centric sustainability, which produces a positive impact along the lines of environmental, economic, and social levels (Sheth, Sethia and Srinivas, 2011). The significance of mindful consumption emerges from the fact that the world is tending towards an unsustainable lifestyle that creates pressure on the limited resources available leading to disturbances in the natural flow of things and people (Manchanda, Arora, Nazir, et al.,2023). The reason is that mindful consumption promotes caring for the self and the community leading to sustainability (Sheth, et al., 2011; Manchanda et al., 2023).

Sheth, et al., (2011) refer to the tangible and the intangible facets of consumption wherein the tangible aspect of the behaviour of consuming and the intangible aspect of the mindset can constitute the whole process of consumption. The mindfulness of

[1]Senior Assistant Professor, Cinmaya Viswa Vidyapeeth, Kochi, Kerala

mindset and the mindfulness of behaviour connotes the conscious and the fully aware process of mindset and behaviour which are regulated by a whole set of intra-individual forces (Sheth, et al., 2011; Fischer, Stanszus, Geiger, et al., 2017).

2. Review of Literature

Delineating the dynamics of mindfulness, Fischer, Stanszus, Geiger, et al., (2017) state that mindfulness is defined in varied terms drawing upon different interpretations that stem from scientific and religious schools, which may be referred to as "conceptual mindfulness" and "non-conceptual mindfulness", respectively (Purser & Milillo, 2017, p.3). The word, "Sati" ("smriti" in Sanskrit), when translated as "remembrance" is the root of the term "mindfulness" and it refers to a state of "lucid awareness of what is occurring within the phenomenological field" (Chiesa, 2012, p.2) along with the other meanings attached to it including recollection, recall,, remembrance,, keeping in mind, absence of floating, and absence of forgetfulness (Purser & Milillo, 2017). The purpose of the practice of Buddhist mindfulness is to bring attention to the present moment (Kang, et al., 2013). It involves the correction of the individual ego attached to and encroached upon by the materialistic pursuits that finally result in achieving a sustained emotional equilibrium and well-being (Chisea, 2012).

The Western view of mindfulness is generally construed operationally and measurably, so that empirical research can be carried out objectively. Concerning this Bishop, Lau, Shapiro, et al., (2006) propose a two-component model of mindfulness wherein the self-regulation of attention and the adoption of a particular orientation sets the stage for mindfulness. By regulating the focus of attention, the individuals can have their attention sustained and be present in the here and now which enables them to have a non-elaborative awareness of thoughts, feelings and sensations as they pop up in the mind (Bishop, et al., 2004). The second component of the model is the orientation to experience wherein regardless of valence, desirability or attachments, the observer approaches the thoughts, emotions or images with openness and curiosity which sets the stage for an intensive and investigative self-observation leading to a greater understanding of the thoughts and feelings, the myriad and the varied nature of it accompanied by the popping up and popping out of unanticipated objects, images, thoughts, memories and forgotten affects (Bishop, et al., 2004). This monitoring of consciousness leads to the development of complex, differentiated and integrated

representations of cognitive and affective experiences (Bishop, et al., 2004). The first component of mindfulness is a mental skill acquired through purposeful attention and the second component underlines the personality tendencies that characterise mindfulness (Chisea, 2012).

Shapiro, et al., (2006) propose a three-component model of mindfulness that consists of intention, attention and attitude which are drawn from the definition of mindfulness as given by Kabat-Zin (2015)… "paying attention (attention) in a particular way (attitude) on purpose (intention), in the present moment, and non-judgmentally" (Shapiro, et al., 2006, p. 375). The intention (that is, the why of practising mindfulness) underscores the whole process of the deliberate way of cultivating mindfulness which can range from self-awareness to self-regulation to self-exploration to self-liberation (Shapiro, et al., 2006). The component of attention is underlined by the capacity to sustain attention on one object, meaningful shifting of attention between objects or mental sets and the ability to inhibit connected/disconnected processing of thoughts, feelings and sensations, labelled cognitive inhibition (Shapiro, et al., 2006). The attitude of acceptance, kindness, openness, and a non-evaluative focus on internal and external experiences determines the quality of mindfulness. The three-component model of mindfulness underlines the cognitive, emotional, behavioural and personality-related processes of mindfulness (Shapiro, et al., 2006).

Mindfulness is a self-focused state that draws attention to the ongoing state of consciousness, moment by moment, thought by thought, emotion by emotion, and feelings by feelings inclusive of all the bodily changes that accompany the mental processes. Devoid of any religious or sectarian interpretation "it is simply a practical way to notice thoughts, physical sensations, sights, sounds, smells - anything we might not normally notice. The actual skills might be simple, but because it is so different to how our minds normally behave, it takes a lot of practice" (Kabat-Zinn,2015). In its simplest form, mindfulness involves gaining attention voluntarily and in a non-judgemental way wherein the mind "draws novel distinctions" (Milne, Ordenes & Kaplan, 2019 p. 2). The Eastern and the Western perspectives of mindfulness diverge as to its focus characterising it in two different ways (Fischer, Stanszus, Geiger, et al., 2017) of summative states and analytical states. The Eastern view dominated by the Buddhist meditation practices construes mindfulness as a summative wholesome process whereas the Western model treats mindfulness as an analytical state composed

of different constituents drawn from the intra-personal processes of the individual (Brown & Ryan, 2003).

The second key term in mindful consumption is mindset interpreted from different angles and analysis. The term 'mindfulness' has two distinct meanings in psychology referred to as “meditation-oriented” and “mindset-oriented”, and it requires further elaborations to better understand the dynamics of the behaviour of consumption (Kang, et al., 2013; Sheth, et al.,2011). The structure and function of the mindset of an individual can be delineated into the cognitive and the non-cognitive realms (Mathews, 2017). The complexity and the structure of the mindset can be understood by the differentiation and integration of cognitive functions that characterise it (Gupta & Govindrajan, 2002). The structure of knowledge that the individual is represented with in the cognitive structures and processes shapes the mindset which is now understood as a predisposition to perceive the world in a predetermined way and as an attitude that enables consistent response (Glaser, 1984; Rhinesmith, 1992; Nielsen, 2014). It is the differentiation and integration of knowledge concerning a particular area like sustainability that defines the nature of a mindset of sustainability. High differentiation and integration of knowledge consolidate the knowledge structure and its use in the development of a sustainable mindset, implying that high differentiation and integration are the mechanisms of differentiating and bringing together large chunks of information, which can also be affect-laden (Gupta & Govindrajan, 2002; Mischel & Shoda,1995; Epstein, 2003).

In the cognitive-experiential self-system theory of Epstein (2003) the “experiential system operates in a manner that is preconscious, automatic, rapid, effortless, holistic, concrete, associative, primarily nonverbal, and minimally demanding of cognitive resources” (p.160) whereas the rational system is “conscious, analytical, effortful, relatively slow, affect-free, and highly demanding of cognitive resources” (Epstein, 2003, p. 161). The experiential system is characterised by the need to maximize pleasure and the need to avoid pain, the need for “stability and coherence in a person’s conceptual system”, the need for relatedness and the need for enhanced self-esteem (Epstein, 2003, p. 162). Applied to the concept of mindset it is evident that the knowledge structures of the individual interact with the affective system, thereby knowledge becomes emotional in the experiential system. The cognitive-affective-personality system theory of Mischel and Shoda (1995) reflects the same finding that

"the organization of cognitions and affects in the system reflects the individual's total experience". The total experience of the individual is comprised of the encodings, expectancies, beliefs, goals and the features of the situation that signature the personality state of the individual (Mischel and Shoda, 1995). "Different experiential systems of cognitive-affective units contribute to stable individual differences in their interaction with the situation or consumption and it may "operate at many levels of awareness, automaticity, and control" (Mischel and Shoda, 1995, p. 259; Mathews, 2024).

Along with the cognitive system that predominantly influences the development and maintenance of the mindset, the emotional dynamics of the individual also play a critical role. The ability to manage tensions, the ability to withstand obstacles, the self-regulatory processes of the individual and tolerance for ambiguity underlie the foundational structure of the mindset (Mathews, 2017). In interaction with the cognitive system, the emotional dynamics of the individual structure the mindset either in a positive vs negative way or in the strong vs weak way that tilt the affect-laded information processing. In the same vein, the motivational processes that oversee the development of a mindset include personal drive, dedication, perseverance, achievement motivation and goal orientation (Mathews, 2017). Arora *et al.* (2004) further consider the plasticity of the mind (flexibility, thinking differently, rebalancing, and openness, having multiple frames of reference), mindfulness, curiosity and humility contributing to the development of mindset (Mathews, 2017). The cornerstones of the mindset as evidenced by the studies point to the intra-individual sub-systems of cognition, affect, motivation and the personality processes that function interactively.

The two key terms of mindfulness and mindset, though it is conceptualized as surface trait/processes are much more encompassing as it draws upon the intraindividual structures and functions of the cognitive processes, emotional dynamics, motivational processes and personality processes. Mindfulness and mindset are not compartmentalized-independent processes as it is made up of the intra-individual subsystems. The processes and the dynamics of mindfulness and mindset are unique to the individual in the same way an individual is unique. In other words, the nature of the processes and the dynamics of mindfulness and mindset are determined by the total personality system of the individual (Mischel & Shoda, 1995; Bishop, et al, 2004;

Brown & Ryan, 2003; Epstein, 2003; Mathews, 2018). The conceptualisations of different authors in the realms of mindfulness and mindset are represented in Fig. 1. The state/trait/disposition of mindfulness is an outcome of interactive relations set up in an individual's interaction with the situation/environment over a period.

The intra-individual system of cognition in its structure and function delineated into the knowledge structure of differentiation and integration can determine the quality of mindfulness as the contingent information processing of the individual turns into either the rational process or the experiential system (Epstein, 2003; Holas & Jankowski, 2012). The meta-cognitive process of monitoring the "object of cognition and the cognition process itself" is constructed of elements of consciousness, unconsciousness and meta-conscious cognitions (Holas & Jankowski, 2012, p.4). The structure and functioning of the cognitive system defined by its differentiation and integration define its quality in terms of its wholesome thoughts and/or unwholesome thoughts, wherein the mind is the sixth sense after the five sense organs that contribute to the construction of conscious experiences (Olendzki, 2013; Schneider & Angelmar, 1993). In the same way, thoughts are significant in mindfulness, the emotions and their regulation too matter in the quality of mindfulness. The experience of different emotions, emotional awareness and emotion regulation characterise mindfulness (Hill & Updegraff, 2012). In the motivational arena, the intention to practice mindfulness, the inner urge that prompts the individual to be mindful and to reach the level of de-automatization plays a significant process in moving from mindlessness to mindfulness (Shapiro, et al., 2006; Holas & Jankowski, 2012). The evolving construct of mindful personality goes a long way in explaining its structure and function in behaviour. The underlying mechanisms and processes of mindfulness of different levels and degrees are related to complex behavioural processes that make it individual-specific (Mesmer-Magnus, Manapragada, Viswesvaran, 2017).

The contention that mindfulness is different from reflexive consciousness as the focus is on cognitive operations and it is "prereflexive," operating on, rather than within, thought, feeling, and other contents of consciousness…" …. and that "mindfulness concerns the quality of consciousness itself" … however does not preclude the view that mindfulness is divested of cognitive, affective, motivational and trait related processes (Brown & Ryanm 2003, p.823; Bishop, et al, 2004; Brown & Ryan, 2003; Epstein, 2003). The state/trait of mindfulness, its content, as well as its context, are

governed by the individual's unique psychic functioning (Holas & Jankowski, 2012). What is generally touted to be a "…bare display of what is taking place…" is equivalent to saying that there is a building without a foundation (Shear & Jevning, 1999, p. 204). In other words, the surface of the sea is made up of deep water and its quality definitely cannot be outside its content and context which again creates the waves that can also be due to the interaction between the internal and the external environment of the sea (Shapiro, et al., 2006; Brown & Ryan, 2003). In the same way, there cannot be the branches, the leaves and the stem of the tree without the roots and the soil around it, the wakeful state of mindfulness defines its quality about its roots of cognition, affectivity, motivational inclinations and trait dynamics of the individual.

This is further corroborated by researchers (e.g., Mesmer-Magnus, Manapragada, Viswesvaran, et al.,2017) who agree that "(a) mindfulness can be achieved without meditation; (b) attaining a mindful state is an inherent human capability; (c) mindfulness is both a state and a trait; anyone can attain a state of mindfulness but there are individual differences in tendency toward mindfulness; and (d) mindfulness is not always deliberate; sometimes it can occur subconsciously" (Mesmer-Magnus, 2017, p. 81).

Mindfulness is not a peripheral /outward flow of focused attention or a focused stream of consciousness. Instead, this flow of consciousness is characterised by intrapersonal dynamics of cognition, affect, motivation and the personality of the individual (Shapiro, Carlson, Astin, et al.,2006; Brown & Ryan, 2003; Bishop, Lau, Shapiro, et al., 2006). The intra-personal dynamics of the individual are unique to each influence the content of the mindful state and the context further determines the way the mindful state operates (Brown & Ryan, 2003; Langer, 2014). Most of the studies conducted on mindfulness focus on its characteristics and effects whereas "the underlying mechanisms of mindfulness remain largely unknown as the available studies do not delve into the conscious and the unconscious mechanisms of mindfulness (Kang, Gruber & Gray, 2013, p.192). This study tries to explore the intra-individual mechanisms that determine the nature of mindfulness by broadening and deepening the construct of mindfulness to better understand the consumption behaviour of the consumer which has implications for sustainability.

3. Model of Mindful Consumption: A Conceptual Framework

The cognitive–affective–motivational-personality (CAMP) process is conceptualised as "…psychological mediating processes…" (Mischel & Shoda, 1995, p.252) that interact with and determine mindfulness and mindful consumption Fig.1. CAMP constructs interact and influence each other in such a way that the overt and the covert behaviour are the net outcome of these interactions Mischel & Shoda, 1995; Schunk and Zimmerman,1994; Baron, 2008; Lazarus, 1991). The interaction between these processes generates related constructs of the intra-individual sub-systems which are analysed in relation to mindful consumption.

The consumptive behaviour is constitutive of an array of endogenous factors in the realms of intra-individual processes unique to the individual consumer as consumption cannot take place in a vacuum making consumption a highly individual-specific lifestyle evolved in the interaction between intra-individual propensities (Elliston et al., 2017; Breslin, et al., 2004; Shemshaki, Ghasemi, Homayouni, et al., 2024). (It may also be noted that consumption is also influenced by exogeneous factors) (Mak, Lumbers, Eves, et al., 2012). The intra-individual sub-systems of the cognitive processes, the affective processes, the motivational processes and the personality dynamics influence consumption patterns through the emergence of related constructs that influence the development of a mindful mindset that is predictive given an understanding of the endogenous and the exogenous process of the individual (Gustavsen & Hegnes, 2020; Mak, et al., 2012). Delineating the intra-individual sub-systems involves identifying the individual-specific processes that lead to the development of mindfulness and a corresponding mindset. Deciphering the structure and function of mindfulness in the light of the extant literature comprises of temporal self-regulatory theory, locus of control, automatic and controlled processing, neuroticism, impulsive and compulsive buying, growth mindset vs fixed mindset, emotional intelligence, theory of planned mindfulness, mindful personality, and mindfulness-based interventions, that becomes the conceptual framework of the model of mediational mechanisms, Fig.1.

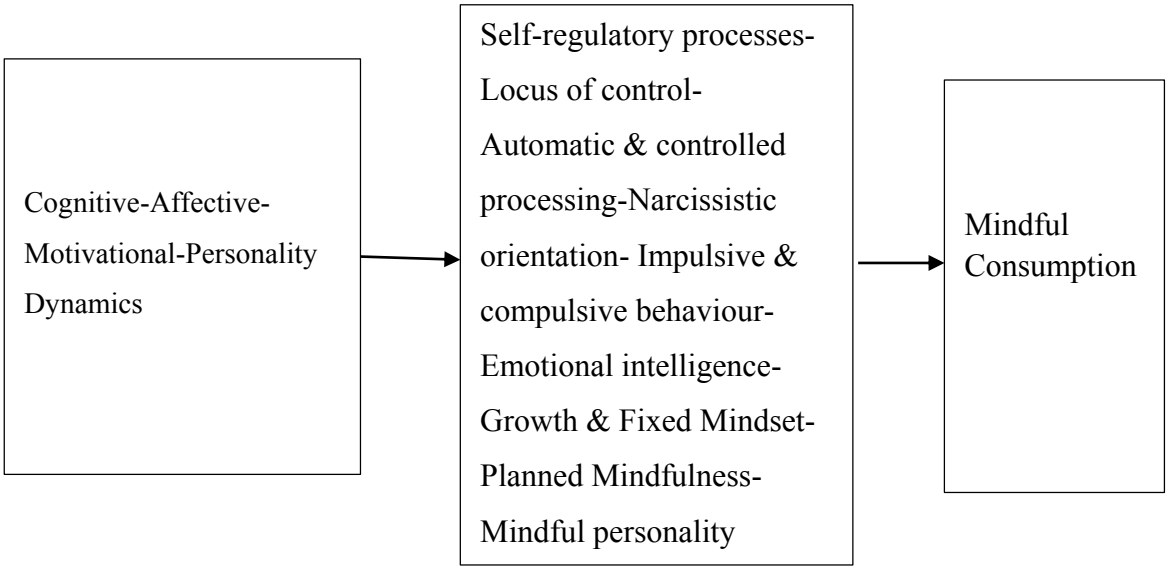

Figure 1: Mindful Consumption: A Conceptual Framework

3.1 Temporal self-regulatory theory (TST)

The crux of the theory is the general tendency that individuals demonstrate in the act of hyper-responsivity to immediate contingencies, and the individual differences in time perspective can explain the behaviour, including consumptive behaviour (Hall & Fong, 2007). TST theory, underlined by cognitive mechanisms, states that the possibility of expected outcomes of value motivates people to engage in such behaviours following intentions (Dorina, Mullan, Boyes, et al., 2023). It is the "connectedness beliefs", that is, the present behaviour will lead to some future outcomes and "temporal valuations", that is, the positive valuation of temporally dispersed outcomes that force them to engage in behaviours (Hall & Fong, 2007, p.14). The two significant variables that the theory employs to finally explain the behaviour are behavioural pre-potency and self-regulatory capacity, which, in conjunction with the motivational sphere, create what is labelled as "ambient temporal contingencies" (Hall & Fong, 2007, p.15). Behavioural pre-potency is determined by the stock of past performance and by the presence of features that can cue the individual to action, whereas self-regulatory capacity refers to the capacity to exercise control over one's behaviour using one's energy (Hall & Fong, 2007). It is the temporal disjunction

between the immediate and the non-immediate valuing of the outcomes that increases the influence of the behaviour pre-potency and self-regulatory capacity. The ambience of temporal contingencies is created by the perceived outcomes of value in a state of disjunction or conjunction, wherein conjunction may lower the influence of behaviour pre-potency and self-regulatory capacity, and disjunction may increase the influence of behaviour pre-potency and self-regulatory capacity (Hall & Fong, 2007)

Applied to consumption behaviour, consumers seeking long-term health benefits are likely to turn away from unhealthy food, preferring non-consumption, whereas individuals motivated by gustatory pleasures easily consume food available without regard to consequences, referred to as unhealthy snacking (Elliston, Ferguson, & Schuz, 2017). In the event of temporal disjunction, the moderating variables of behavioural pre-potency and self-regulatory capacity determine the consumptive behaviour, which in other words means that consumers guided by momentary cues, situational prompts, easy availability of food, stress/ tensions/anxiety, or peer pressures lead to indulgence or overindulgence in the eating behaviour (Hall & Fong, 2007). In the same vein consumers with self-regulatory capacity can resist the temptation to unwanted or overeating behaviours in comparison to individuals with low self-regulatory capacity (Elliston et al., 2017). The inference to be drawn is that in the event of temporal disjunction individuals are likely to be moved by momentary desires and demands of the environment, leading to mindless consumption. Individuals with high behavioural pre-potency and low self-regulatory capacity practice mindless consumption, whereas individuals with low behavioural pre-potency and high self-regulatory capacity are likely to practice mindful consumption.

3.2 Locus of control

The control locus of the individual, in accordance with this cognitive theory of personality, can be placed either inside the individual or outside the individual as propounded by Rotter (Caliendo & Hennecke, 2022). The theory of locus of control states that individuals can be differentiated by their perceived control that extends to outcomes, events and circumstances of their lives. The individual's perception of the cause of behavioural outcomes like success or failure or whatever happens to the individual can be because of the influence of internal factors like ability/effort or external factors like fate/luck/ external agencies. The influence of these beliefs

provides a sense of control to the individual, and the individual feels that either he is in control of his life, or it is controlled by external factors. The belief and the feelings of control in one's life permeate the thought and overt behaviour of the individual, thereby the individual can act of his own volition, setting aside the influence of external contingencies. The internal and external control dimensions have become the focus of significant research in many areas of life, including consumer behaviour.

Locus of control as a personality process becomes a significant predictor of related behaviours (Tsuda, Tanaka & Matsuda, 2020). In the studies relating locus of control and mindfulness, it is found that mindfulness also influences and changes the dynamics of locus of control (Oguntuase & Sun, 2022). Individuals who are mindful and who have developed greater insights into their internal functioning through mindfulness-based programmes are found to be showing greater ability and confidence in controlling their events in life and through a process of reperceiving they come to perceive that barriers to goal accomplishment are no longer insurmountable and not indicators of personal incompetency (Oguntuase & Sun, 2022). In a significant study by Heidari and Kumar (2019), it was shown that individuals with an internal locus of control show greater depths of mindfulness. Individuals with an internal locus of control demonstrate higher commitment and willingness to perform difficult tasks as they set goals and control events (Oguntuase & Sun, 2022). Studies have shown that locus of control influences the decision-making process of the buyer (Caliendo & Hennecke, 2022). Internal locus of control can influence the awareness, attitude and behavioural intention of the consumer (Toti, Diallo & Huaman-Ramirez, 2021). Internals are also found to engage in higher information processing, and they seek to control the environment, and the same can be reflected in the consumer behaviour, which means that internals can be more mindful consumers than externals (Toti et al., 2021).

3.3 Automatic and controlled processing

The view that human cognition comprises the dual processing of automatic and controlled is well recognised in theory and research. Automatic processing denotes, as the name implies, the instant activation without the necessity of attention of the subject, of sequences of cognitions and corresponding behaviours in response to an input of stimuli (Schneider & Chein, 2003). The process becomes automatic and

effortless, and it does not demand the attention of the subject in a specific way and this is because of the presence of a set of permanent associations connected to the stimulus input (Schneider & Chein, 2003). Controlled processing on the other hand, involves the activation of a few sequences of cognitions directed by the attention of the subject, which can be altered or further processed by the subject. It may be noted further that a process becomes automatic through training and habituation of responses, whereas in controlled processing, the subject is still in the learning mode of experimentation and can exercise control as to the manipulation of cognitions (Schneider & Chein, 2003). Automatic process is so common in our everyday lives as it takes place without effort on our parts and it is symptomatic of mindlessness, whereas controlled processing can be equated with mindfulness-based behaviour.

In an information processing analysis of automatic processing, it is equated with "overlearned patterns of thoughts and emotions" and "conditioned motivations… encoded in a memory network containing propositional information…" (Breslin, Zack & McMain, 2004, pp. 283, 284). The repetitive, habitual and conditioned thoughts of motivation that exemplify the automatic processing are further corroborated in the cognitive experiential self-system theory of Epstein (2003), wherein the automatic processing is characterised as preconscious, automatic, rapid, effortless, associative, primarily nonverbal, and minimally demanding of cognitive resources and the controlled processing is of the nature of conscious, analytical, effortful, relatively slow, affect-free, and highly demanding of cognitive resources (Epstein, 2003). The experiential system and automatic processes are identical in that it take place without the effortful attempt of the subject and are loaded with affect-laden information. Mindful meditation-based practices teach individuals to do away with the automatic, distracting or random thoughts and emotions that arise in the states of consciousness by a process of accepting the distractions as they arise and disappear in the mind, paving the way for non-automatic/effortful processing of mindfulness (Breslin, et al., 2004).

3.4 Neuroticism

Neuroticism, a stable temperament of negativity, frequently associated with negative emotionality, anxiety, worry and disquiet is a robust higher-order personality trait of significance in the interpretation of an individual's behaviour (Angarita-Osorio,

Escorihuela & Canete, 2024). Eysenck suggested neuroticism as a key dimension of personality which again became prominent in the Big Five Factor model of personality characterised as emotionally unstable, anxious, prone to experience psychological distress and discomfort and negative emotions that unsettle the life of an individual. It is a complex construct of irrational thinking styles, negative thinking accompanied by cognitive reactivity, increased negative emotional reactivity and disordered and maladaptive arousals and depressive symptoms mediated by ruminative tendencies and lonely states (Barnhofer, Duggan & Griffith, 2011). Emotional instability a key marker of neuroticism throws the individual into unpredictable mood swings of depression and hyper-sensitive cognitive reactions that create an internal turmoil in the cognitive and affective system of the individual (Angarita-Osorio, et al., 2024). The characteristics that go with affective instability as per the identification of Westen, Muderrisoglu, Fowler, et al., (1997) include the intensity of affect, lability, the constant tendency to experience pleasant and unpleasant emotions, mood swings, the tendency to experience particular affects like hatred, anxiety, the consciousness of affective experience, capacity for experiencing ambivalent emotions, and emotional expression, and overreactions as well as low reactions, denoting unstable and disordered emotional states. Cognitively and affectively neuroticism is negatively correlated with mindfulness and or positively correlated with mindlessness (Barnhofer, et al., 2011; Angarita-Osorio, et al., 2024).

The dispositional mindfulness facets of non-judging, non-reactivity and acting with awareness show a negative correlation with anxiety, anger, depression, self-consciousness, immoderation, and vulnerability (Angarita-Osorio, et al., 2024). Using the Five Factor Mindfulness Scale, Mather, Ward, and Cheston (2019) measured the facets of Observing-Describing - Acting with Awareness – Non-Judging of Inner Experience – and Non-Reactivity to Inner Experience (Mather, et al., 2019) It was found that there was an inverse relationship between the trait of neuroticism and the domains of non-judging of inner experience, non-reactivity to inner experience and acting with awareness, which according to Mather et al. (2019) aligns with the dispositional mindfulness domains of conscious awareness, self-compassion and acceptance. The inference to be drawn from the relationship between neuroticism and mindfulness is that moderate to high neuroticism is predictive of mindless consumption.

3.5 Impulsive and compulsive buying

Rook and Fisher (as cited by Bayley & Nancarrow, 1998) consider impulse buying as a personality trait and define it as "a consumer's tendency to buy spontaneously, *unreflectively*, immediately and kinetically" (p.101). Impulse buying is found to have several characteristics like being overwhelmed by the force of the product, a moving feeling that pushes the individual to buy the product instantly and without reflection, discarding the consequences of buying without any apparent logic, being overexcited by the purchase, disregarding of the price factor and total disregard of the use and necessity of buying (Rook, as cited by Bayley & Nancarrow, 1998). Bayley and Nancarrow (1998) refer to the self-willed impulse of being semi-consciously directed to the purchase and the captivated impulse of being conquered by the passion of buying and the consumer feels "totally out of control" (p.110).

Compulsive buying, according to Lejoyeux and Weinstein (2010) is an addictive disorder in which the buyers are found to be having an "…irresistible, and overpowering urges to purchase goods…" without any sense of its possession. The goods purchased may be useless or unused items, wherein it is the addictive act of buying that stands out rather than having the goods in one's possession (Lejoyeux & Weinstein, 2010). Compulsive purchasers, who show a chronic and repetitive tendency to buy in response to internal conflicts and pathology, are found to have very low self-esteem, higher levels of tendency to fantasize, and higher levels of anxiety, depression and obsession (Shoham & Brencic 2003). Edwards (1993) depicts compulsive buyers on a continuum that ranges from normal buying (non-compulsive) to recreational buyers who spend to relieve stress or to celebrate to a compulsive buyer who buys to relieve anxiety and the addicted spender whose buying behaviour has created dysfunctions in his/her daily lives.

Impulsive and compulsive buying go against state/trait/ dispositional mindfulness in that the here and now of mindfulness anchors the person at the present moment whereas impulsivity and compulsiveness force/urge the person to go for impulsive/compulsive shopping/buying behaviour (Hua, 2022). Mindfulness is considered an antidote to impulse buying which in other words refers to the fact that those with a high state of mindfulness show decreased levels of impulsivity/ compulsivity in their buying behaviour possibly because of the greater level of control

of the cognitive and the affective process of the buyer (Hua, 2022; Vihari, Sinha, Tyagi, et al., 2022). Mindfulness provides the individual with higher here-and-now awareness that promotes greater cognitive control and regulation of the disarrayed/disordered emotional states besides containing the "automaticity in behaviour" thoughtlessness and fuming emotionality (Vihari, et al., 2022, p.03). The findings indicate that impulsivity positively correlates with mindless consumption and reflection positively correlates with mindful consumption.

3.6 Growth mindset vs fixed mindset

The mindset theory as formulated by Dweck & Legget, (1988) (Kapasi & Pei, 2022) drawing upon an individual's orientation towards performance goals and mastery-oriented goals refers to two broad groups of beliefs labelled fixed mindset and growth mindset, respectively. Performance goals can be characterised as maladaptive behaviour patterns that stem from a fixed mindset and mastery-oriented goals are adaptive and challenge-seeking that stem from a growth mindset (Dweck & Legget,1988). A fixed mindset (an entity theory of intelligence) refers to a negative belief of not being able to utilise one's intelligence where the individual feels helpless (Dweck & Legget,1988; Kapasi & Pei, 2022) A growth mindset (an incremental theory of intelligence) implies a mindset of developing, utilising and cultivating intelligence to solve problems with effort and experience where the individual feels mastery-oriented where the individual thinks and feels he is in control of the efforts to do significant tasks (Dweck & Legget,1988; Kapasi & Pei, 2022). It is this growth and fixed mindsets that can also shape mindfulness wherein the fixed mindset imposes implicit limitations of draining away attentional resources and lack of freedom on the individual and the growth mindset provides freedom and steadiness of attentional resources to the individual (Samuel & Warner, 2019). Individuals with a growth mindset are prone to developing mindfulness revealed in their persistence with the task and the motivation to continue attempting to be successful and not be afraid of failure (Dweck & Legget,1988). It is shown that moving from a fixed mindset to a growth mindset also changes the perception of the individual which aligns with the characteristics of mindfulness (Samuel & Warner, 2019).

3.7 Emotional intelligence

In the background of differing definitions of emotional intelligence (EI), one definition that is inclusive of it states that emotional intelligence is about reasoning with emotions and the use of emotions to improve thought (Mayer, Roberts,& Barsade, 2008). Generally, EI is studied under three different classifications ability EI, mixed EI and self-report EI (Miao, Humphrey & Qian, 2018). The ability EI treats EI in the way intelligence is treated and it is an ability of innate nature and the measures of it are emotional perception, using emotions to facilitate thought, understanding emotions, and managing emotions (Miao, et al., 2018). The self-report and mixed view of emotional intelligence considers EI as a constellation of behavioural measures, traits and non-cognitive abilities (Miao, et al., 2018). Researchers agree that trait mindfulness and EI share common characteristics like being aware of one's own emotions as well as the emotions of others, perceptual clarity of one's emotional states, appraisals of emotion, use of emotion, regulation of emotion, adaptive emotional functioning and the overlapping extends to cognitive and non-cognitive facets of EI and mindfulness (Miao, et al., 2018). Individuals with high EQ may practice mindful consumption in comparison to individuals with low EQ.

3.8 Planned mindfulness

The theory of planned mindfulness as suggested by the author is grounded in the theory of planned behaviour in that by the theory of mindfulness as proposed by Shapiro, et al. (2006), intention, attention, and attitude determine the state of mindfulness. The meditator intends to free the mind from the clutches of automaticity and attachment to a state of here-and-now awareness of living in the present moment which becomes a moment-to-moment state as well as a trait of mindfulness. The attitude of the meditator according to Shapiro, et al., (2006) is governed by the attitudes of patience, compassion and non-striving that drive away unwholesome and aversive thoughts. Likewise in the theory of planned behaviour, the intention to act is contingent on the three considerations of the behavioural beliefs about the occurrence of the valued outcomes that will produce a favourable attitude to the formation of intention and behaviour, the subjective norm of behaving consequent to the social pressure to behave in a specified way and the control belief of self-efficacy that this perceived behavioural control is also an antecedent to behavioural intention and the actual behaviour

(Bosnjak, Ajzen & Schmidt, 2020) In other words, the theory of planned mindfulness posits that the attainment of mindfulness is dependent on three sets of factors of intention, attention and attitude (Bosnjak, et al., 2020; Shapiro, et al., 2006).

The theory of planned mindfulness is what is implied in mindfulness-based interventions that becomes effective through the process of intention, attention and attitude. In the ongoing process of mindfulness meditation, according to Kristeller, (2007) first of all, the individual becomes aware of the rise and fall of thoughts and emotional experiences leading to deconditioning the habitual patterns of thoughts and emotions. Secondly, the associative link between the stimulus and the responding thoughts and the emotional experiences which are automatic is severed, thereby new patterns of responding emerge. This disengagement of the habitual thought patterns and the experience of emotions, "the usual chatter of the conscious mind" paves the way to "liberation and freedom, a release from operating on "automatic" mediated through the process of intention, attention and a favourable attitude (Kristeller, 2007, p.396; Shapiro, et al., 2006).

3.9 Mindful personality

Mindful personality is a construct that draws together a set of personality processes that bear a significant relationship with dispositional mindfulness. A mindful personality differs from a non-mindful personality in its constellation of traits and processes that overlap with mindfulness as a trait/state/disposition. Well-adjusted individuals show higher levels of mindfulness in which it is surmised that they do not act without awareness in managing stress perceptions, followed by non-judgmental awareness and less reactivity (Altizer, Ferrel & Natale, 2020). In the same way, contrary to the popular notion, mindfulness and ambition are consistently related wherein ambition involves being competitive, enthusiastic, energetic, zestful, alert and always on the go (Altizer, et al., 2020). Ambition takes the form of imitativeness and internal and external engagement by describing, and acting with awareness, nonjudgment, and nonreactivity (Altizer, et al., 2020). A significant study by Beaulieu, Proctor, Gaudet, et al. (2022) found that high mindfulness is associated with high assertiveness (extraversion), energy level (extraversion), productiveness (conscientiousness), sociability (extraversion) compassion (agreeableness), respectfulness (agreeableness), trust (agreeableness), responsibility

(conscientiousness), and intellectual curiosity (open-mindedness). It may be added that these traits are sub-classifications of the Big Five Factor Model (Beaulieu, et al., 2022). It is safe to assume that a mindful personality is also a personality of mindful consumption.

The key mediational mechanisms of cognitive -affective-motivational-personality process in the event of mindful consumption can be summarised in Table 1.

Table 1. CAMP variables relating mindful and mindless consumption

Factor	Mindful consumption	Mindless consumption
Temporal Self-regulation	Low behavioural potency & high self-regulation	High behavioural potency and low self-regulatory capacity
Locus of control	Internal locus of control	External locus of control
Automatic and controlled processing	Controlled processing	Automatic processing
Neuroticism	Low neuroticism	High neuroticism
Compulsive & impulsive buying	Compulsive & Impulsive personality	Reflective
Mindset	Growth mindset	Fixed mindset
Emotional intelligence	High emotional intelligence	Low emotional intelligence
Theory of planned mindfulness	Planned mindfulness	Unplanned mindfulness
Mindful personality	Mindful processes	Mindless processes

4. Implications

In the original conceptualisation of mindful consumption of Sheth, et al., (2011) the two key concepts advanced are mindful mindset and mindful behaviour, that does not go further into the dynamics of mindfulness. The conceptual analysis carried out in this paper delineates the underlying mechanisms that mediate mindful consumption.

Mindful consumption in the context of sustainability becomes significant as the practice of mindful consumption is supposed to be contributing to a healthy life of individuals as well as dealing with the problem of ecological crisis (Sheth, et al., 2011). The framework suggested entails the nature and dynamics of the intra-individual sub-systems that determine the pattern of consumption without considering the factors that go with community/ society. More than the causative factors that can tilt the consumption styles, what is emphasised in this framework is the focus on the individual dynamics. Unravelling the individual dynamics of mindful consumption, Table 1, points to the fact that creating awareness about mindful consumption involves understanding the individual personality dynamics. Promotion of mindful consumption as a means of sustainability is the responsibility of manufacturing and service providers, advertisers, citizen groups, social agencies and government organisations that shed light on the necessity and the ways of practising mindful consumption. Shedding light on the individual dynamics of mindful consumption is the starting point of consumption for sustainability.

5. Conclusions

The cognitive-affective-motivational-personality dynamics that mediate mindful consumption as intra-individual sub-systems that influence the structure and function of mindfulness draw attention, first of all, to the fact that the nature and dynamics of these sub-systems vary across individuals. In accordance with this observation, it is evident that mindfulness is primarily an individual-based psychological process keeping the fact that mindfulness is also understood and interpreted in other ways of thought including the religious and spiritual views. Contrasting the Eastern and Western views of mindfulness, the conceptual framework that is suggested here goes well with both Eastern and Western views as it synthesises the contributions from both ends. The Western analytical view that delineates the components of mindfulness is brought forward here and the Eastern holistic view also holds good in relation to the conceptual framework as it cannot overlook the mortars that make up the structure of mindfulness.

A second conclusion of the model is that the interaction processes and their pattern between the intra-individual sub-systems vary between individuals, as each of these sub-systems can be characterised differentially in its individual-specific uniqueness of

structure and function. It means that an individual with better attentional resources and emotional stability may experience a heightened state of mindfulness in comparison to an individual with low attentional resources and low emotional stability, keeping the motivational and personality processes of the individual as constant.

A third conclusion of the model is that the state of mindfulness of an individual brought about either by planned interventions or by unplanned ways is contingent on the net effect following the interaction between the intra-individual sub-systems. It means that, for example, an individual with low emotional stability can nurture the state of mindfulness provided he enjoys the motivational propensity to correct the structure and function of mindfulness in a planned way. It is the net interactional outcome that finally determines the nature of mindfulness.

And finally, the Gestalt view of whole vs. parts readily applies in the development of the state of mindfulness. The overall experience of mindfulness is not merely a summative state as the quality of mindfulness again depends on the unique combination of the sub-systems rather than a specific sub-system unsettling the whole process. It is the interactional outcome produced due to differing combinations of the sub-systems that culminates in the state of mindfulness

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Exploring the Product-as-a-Service (PaaS) Circular Business Model: Opportunities and Challenges

Dr. Rizwana Khanum[1]

Ms. Davita Sananda[1]

Ms. Jhanavi.N[1]

Abstract

The Product-as-a-Service (PaaS) model represents a significant shift in business practices, moving from traditional ownership to a service-oriented approach emphasising sustainability and resource efficiency. This research paper explores the PaaS model within the context of circular business frameworks, assessing its potential to facilitate the transition to a circular economy. By analyzing case studies across various industries, the paper will identify the benefits and challenges of implementing PaaS, including its impact on consumer behaviour, resource management, and economic viability. Ultimately, this study seeks to provide actionable insights for businesses considering adopting PaaS strategies, contributing to the broader discourse on sustainable financial practices.

Keywords: Product-as-a-service, Business model innovation, Sustainable financial practices

1. Introduction

The emergence of Product-as-a-Service (PaaS) represents a transformative shift in business paradigms, marking a decisive move from traditional ownership-based models to service-oriented frameworks that prioritise sustainability and resource efficiency (Noman, A). As we enter 2025, this evolution has become increasingly significant in addressing global sustainability challenges and reshaping business operations across various sectors. PaaS has emerged as a crucial component of the circular economy, offering a promising pathway to decouple economic growth from resource consumption.

[1]Assistant Professor, St Joseph's University Bangalore India

The fundamental idea of PaaS lies in its innovative approach to product ownership and utilisation. Instead of selling products outright, companies retain ownership while providing customers access to the product's functionality through service agreements (Noman, A). This model has gained substantial traction across diverse industries, from manufacturing to technology sectors, demonstrating its resourcefulness and flexibility in meeting emerging market demands while simultaneously addressing environmental concerns.

The significance of PaaS in sustainable business transformation cannot be overstated. As organizations worldwide grapple with increasing pressure to reduce their environmental footprint, PaaS offers a structured approach to resource optimization and waste reduction. The model inherently promotes product longevity, maintenance, and efficient resource utilisation, aligning perfectly with circular economy principles.

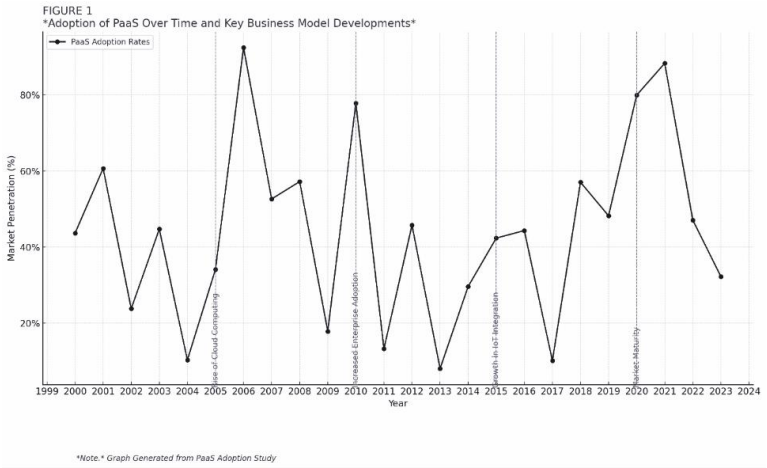

Figure 1: Adoption of Paas over Time and key business model developments

This alignment has become particularly relevant as global sustainability initiatives gain momentum and regulatory frameworks increasingly emphasize environmental responsibility.

The transition to PaaS represents more than just a business model innovation; it signifies a fundamental shift in how society perceives ownership and consumption. This transformation has been accelerated by technological advancements, changing consumer preferences, and growing environmental awareness. The model's ability to

create value while minimizing environmental impact has made it attractive for businesses seeking to maintain competitiveness while contributing to sustainability goals.

The circular economy context within which PaaS operates provides a framework for understanding its broader implications. By enabling the continuous flow of materials and products through the economy, PaaS facilitates the implementation of circular principles such as design for durability, reuse, and recycling. This systematic approach to resource management represents a departure from the traditional linear economy model of "take-make-dispose."

The evolution of PaaS has been marked by significant technological enablers, including Internet of Things (Io) integration, advanced analytics, and digital platforms that facilitate seamless service deivery and monitoring. These technological capabilities have enhanced the model's effectiveness in tracking product performance, predicting maintenance needs, and optimizing resource utilisation throughout the product lifecycle.

From a business perspective, PaaS offers numerous advantages, including predictable revenue streams, stronger customer relationships, and improved product lifecycle management. However, the transition to this model also presents challenges, particularly regarding initial investment requirements, organisational restructuring, and the need for new capabilities in service delivery and customer relationship management. The research significance of exploring PaaS within the circular economy context lies in its potential to provide insights into sustainable business model innovation. As organisations seek to navigate the complexities of environmental sustainability while maintaining economic viability, understanding the opportunities and challenges associated with PaaS implementation becomes crucial.

The innovation point of this research lies in its comprehensive examination of PaaS as both a business model innovation and a sustainability enabler. This study contributes to the growing body of knowledge on sustainable business transformation by analysing the interaction between service-oriented business models and circular economy principles. The research addresses a critical gap in understanding how organizations can effectively implement PaaS while maximizing its potential for environmental and economic benefits.

As we progress through 2025, the relevance of PaaS continues to grow, driven by increasing environmental concerns, regulatory pressures, and changing consumer preferences. This research aims to provide actionable insights for organizations considering the adoption of PaaS models, while contributing to the broader discourse on sustainable business practices and circular economy implementation. The methodology employed in this research combines theoretical analysis with empirical investigation, examining real-world applications of PaaS across various industries. This approach enables a comprehensive understanding of both the theoretical foundations and practical implications of PaaS implementation within circular economy frameworks.

Looking ahead, the potential of PaaS to drive sustainable business transformation appears promising. As organizations continue to seek ways to reduce their environmental impact while maintaining profitability, the insights generated from this research will become increasingly valuable. The findings will not only contribute to academic understanding but also provide practical guidance for businesses navigating the transition to more sustainable operations through PaaS implementation. This introduction sets the stage for a detailed exploration of PaaS within the context of circular business models, examining its potential to facilitate sustainable business transformation while addressing the associated opportunities and challenges. The subsequent sections will delve deeper into specific aspects of PaaS implementation, providing evidence-based insights and recommendations for successful adoption.

While the theoretical and conceptual benefits of PaaS models are well documented, there is a deficiency in empirical research detailing the actual challenges, operational barriers and success factors encountered during implementation across industries. Furthermore, the literature lacks robust evidence linking PaaS adoption to measurable business and sustainability outcomes at scale, particularly in diverse regulatory and cultural contexts.

Addressing this gap is crucial, as organisations worldwide are mandated to reduce environmental impact yet require practical to achieve sustainable transformation without sacrificing economic viability. This study responds by providing multi-industry, evidence-based insights, contributing to both circular economy theory and managerial best practice.

2. Review of Literature

The cited literature in the provided document offers a robust, interdisciplinary overview of the product-as-a service(PaaS) circular business model, integrating foundational theory, empirical research, technological advancements, and sustainability perspectives. Introduced and popularized by Vandermerwe & Rada (1988) the concept of servitization, which is the process by which businesses evolve from solely offering physical products to providing integrated products and services aimed at delivering value throughout the entire lifecycle of usage. This paradigm shift underpins the Product-as-a-Service (PaaS) model, which moves away from one-time product sales toward offering ongoing access, utility, and support, frequently retaining product ownership within the provider's domain.

Noman et al. (2022) expand on the definition and practical evolution of PaaS, situating it firmly within sustainability-oriented business model innovation. Their work emphasizes that PaaS is characterized by the provider’s retention of product ownership and the customer’s role shifting from owning to accessing product outcomes through service agreements. This approach aligns with circular economy principles, enabling companies to optimize resource use, extend product lifespans, and foster recurring revenue streams while reducing environmental impact. Noman et al. highlight the increasing relevance of PaaS in a global context marked by resource constraints, sustainability regulations, and changing consumer values

Many researches underscores the measurable economic and operational impacts of PaaS (Hunhevicz et al. 2021). Their work highlights the use of performance contracts, lifecycle cost analysis, and platform-enabled services as mechanisms that improve maintenance efficiency, reduce downtime, and create steady revenue streams for providers. Empirical Analysis: PaaS Economic benefits and technology enablement Authors delivers empirical insights into PaaS implementation. Their study highlights:

- Economic benefits: PaaS providers achieve more predictable, recurring revenue through subscription and service contracts. The model optimizes asset utilization, lowers lifecycle costs and incentivise product longevity.
- Adoption barriers: Transitioning to PaaS entails organisational restructuring, upfront investments, and changes to established customer relationships.

- Technology/platform enablement: Successful PaaS models rely on digital platforms. IOT integration and analytics for real-time performance monitoring, predictive maintenance, and dynamic service delivery, significantly improving operational efficiency and customer value.

The focus on the digital infrastructure enabling modern PaaS identified as a significant dimension (Zahran et al.2023; Cuellar & Johnson 2022). Key findings relate to the roles of the Internet of Things (IoT), blockchain, and smart contracts. Their research demonstrates how digital twins, real-time monitoring, and secure data exchanges create transparency and efficiency in service delivery while raising new challenges in data governance, cybersecurity, and regulatory compliance.

Muscillo et al. (2021) advance the sustainability impact of PaaS, particularly in urban contexts where circular models are most urgently needed.Their studies quantify the reductions in GHG emissions and waste made possible through extended product use, proactive maintenance, and closed-loop logistics-reinforcing the value of PaaS for sustainable development. Further, Gelashvili et al. (2020) and Ozkan et al.(2023) examine how PaaS aligns with and challenges circular economy principles. Their research shows:

- Alignment: PaaS supports circularity by fostering reuse, refurbishing, and recycling, as providers retain ownership and thus responsibility for the full product lifecycle. This approach leads to better resource management, reduced waste and enhanced environmental performance.
- Tensions: Implementing PaaS in diverse regulatory, technical, and cultural contexts can create tensions. These include difficulties with reverse logistics, infrastructure demands, and the need for standardised metrics and practices that address both customer expectations and sustainability goals. These foundational and empirical works collectively demonstrate that PaaS is not just a business innovation but also as a critical component of the circular economy enabling sustainable value creation while posing new operational, technological and systematic.

The role of the circular economy in enhancing resource efficiency by applying the 4R framework - reducing, reusing, recycling, and recovering was examined the circular

principles (Abid et al. 2024). Their research emphasizes how circular approaches and business models like PaaS can minimise waste generation while optimizing material use in industrial processes and product lifecycles. The study highlights the potential of PaaS to operationalise these concepts by promoting extended product use and responsible consumption patterns, thus driving sustainable production systems aligned with global environmental goals.

The transformative impact of emerging digital technologies, such as blockchain and the Internet of Things (IoT), on service-based business models in agriculture was examined by Cuellar and Johnson (2022). Their research illustrates how these technologies enhance transparency, traceability, and trust across service networks by enabling smart contracts and real-time data sharing. The integration of blockchain with PaaS models facilitates better lifecycle tracking and circular flows of products, which are essential for sustainable resource use and regulatory compliance in circular economy frameworks

Gan et al. (2023) investigate the application of artificial intelligence (AI) and machine learning in enhancing PaaS revenue models and customer relationship management. They demonstrate that advanced data analytics enable dynamic pricing strategies based on actual product usage, improving profitability while aligning with sustainable service delivery. Furthermore, AI-powered CRM systems foster personalized customer experiences by leveraging usage patterns and sentiment analysis, which strengthens customer retention—a crucial factor in the success of PaaS business models. Sooner, an analyse of how technological progress enables businesses to adopt flexible and accessible Product-as-a-Service models with comparatively lower investment thresholds are studies (Araujo, Vazquez, and Cota 2014). Their study highlights the role of digital platforms in facilitating service delivery and customer engagement, which are key enablers for the scalability of PaaS offerings. Moreover, they discuss the challenges companies face when integrating these platforms within legacy systems and emphasize the importance of strategic alignment to overcome such barriers

Qiu et al. (2025) investigate the integration of nuclear energy within the circular economy frameworks, offering insights relevant to energy-intensive sectors implementing PaaS. Their findings underscore how PaaS models can contribute to

optimizing energy consumption through improved asset utilization and predictive maintenance, especially when combined with sustainable energy sources. This synergy supports both economic resilience and environmental objectives central to the circular economy paradigm.

3. Theoretical framework

The theoretical framework for understanding Product-as-a-Service (PaaS) within circular economy contexts requires a comprehensive analysis of multiple interconnected theories and principles. The foundation of this framework rests upon the integration of circular economy principles with servitization theories, creating a novel approach to sustainable business practices (Gelashvili, T, 2020). The circular economy concept fundamentally challenges the traditional linear economic model of "take-make-dispose" by promoting the principles of regeneration, sharing, optimization, looping, virtualization, and exchange (Özkan, O, 2023).

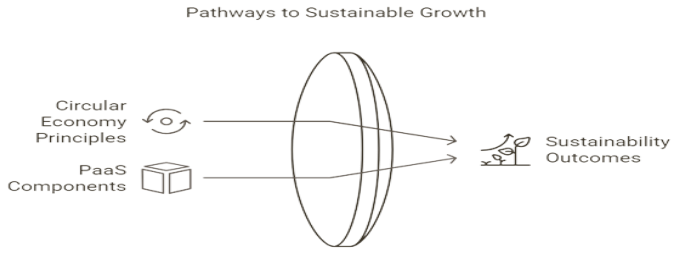

Figure 2: Interconnections between main components

In examining the theoretical underpinnings of PaaS models, it becomes essential to understand how servitization transforms traditional product-centric business approaches into service-oriented solutions. This transformation aligns with the circular economy's core principles by enabling more efficient resource utilization and extended product lifecycles (Noman, A, 2022). The theoretical framework must consider both the operational and strategic dimensions of implementing PaaS models within circular economy contexts. Figure 2 shows Circular diagram showing interconnections between three main components - 1) Circular Economy Principles (Regenerate, Share, Optimize, Loop, Virtualize, Exchange) 2) PaaS Components (Service Design, Resource Management, Customer Relationship, Revenue Models) 3) Sustainability

Outcomes (Environmental Impact, Economic Viability, Social Benefits) with bidirectional arrows indicating relationships and feedback loops

This framework suggests that businesses can achieve sustainability goals while maintaining economic viability through service-based offerings (Noman, A, 2022). The theoretical model incorporates elements of systems thinking, recognizing that PaaS operates within a complex foundation emphasising value retention and resource optimisation network of stakeholders, resources, and environmental considerations.

A key theoretical consideration is the concept of value creation in PaaS models. Unlike traditional product-based businesses, value in PaaS is generated through continuous service delivery and long-term customer relationships. This shift requires a theoretical understanding of how value is created, delivered, and captured in service-oriented business models (Gelashvili, T, 2020). The framework must account for both tangible and intangible value components, including environmental benefits, customer satisfaction, and resource efficiency.

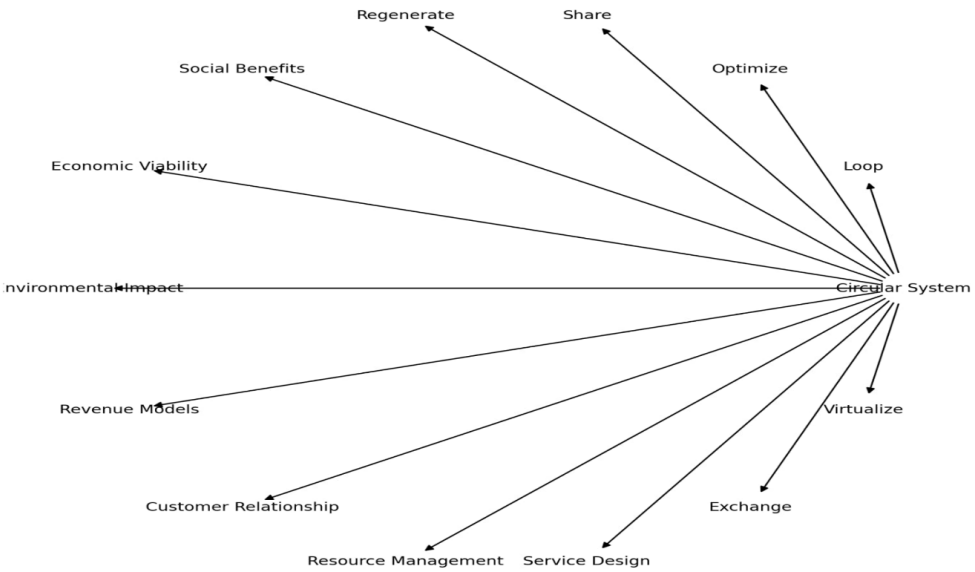

Figure 3: Integrating circular economy principles into PaaS model

The theoretical framework also addresses the role of technology and innovation in enabling PaaS implementation. Digital technologies, the Internet of Things (IoT), and data analytics serve as crucial enablers for successful PaaS operations (Noman, A, 2022). These technological components must be integrated into the theoretical framework to explain how they facilitate the transition from traditional business models to circular economy-aligned PaaS solutions. Sustainability theory is central to this framework, particularly in understanding how PaaS models contribute to environmental, social, and economic sustainability. The framework incorporates concepts from industrial ecology, suggesting that business systems should mimic natural ecosystems in their efficiency and circular nature (Özkan, O, 2023). This theoretical perspective helps explain how PaaS models can contribute to broader sustainability goals while maintaining business viability.

The framework also considers behavioural theories, particularly in understanding customer adoption and acceptance of PaaS models. These theories help explain the shift from ownership to access-based consumption, which is fundamental to the success of PaaS implementations (Noman, A). Understanding consumer behaviour and preferences becomes crucial in designing effective PaaS offerings that align with circular economy principles. Resource-based view (RBV) theory provides another important theoretical lens for analyzing PaaS models. This perspective helps explain how companies can develop competitive advantages through unique combinations of resources and capabilities when implementing PaaS solutions (Gelashvili, T, 2020). The framework considers how organizations can leverage their existing resources while adapting to new service-oriented business models.

The theoretical framework must also address the institutional and organizational changes required for successful PaaS implementation. This includes understanding how organizations can transform their operations, culture, and capabilities to support service-based business models. The framework incorporates change management theories to explain the organizational transformation process required for PaaS adoption. Innovation theories, particularly those related to business model innovation, form another crucial component of the theoretical framework. These theories help explain how organizations can design and implement novel PaaS solutions that create value while adhering to circular economy principles (Özkan, O, 2023). The framework

considers incremental and radical innovation approaches in the context of PaaS implementation.

Finally, the theoretical framework addresses the economic aspects of PaaS models, incorporating concepts from service economics and circular economy financing. This includes understanding how revenue models, cost structures, and value capture mechanisms operate in PaaS contexts. The framework provides a theoretical basis for analysing the economic viability of PaaS implementations while maintaining alignment with circular economy principles. This comprehensive theoretical framework provides a foundation for understanding how PaaS models can effectively contribute to circular economy objectives while maintaining business viability. It integrates multiple theoretical perspectives to explain the complex interactions between service-based business models, circular economy principles, and sustainability outcomes. The framework serves as a basis for analysing existing PaaS implementations and guiding future research in this field.

4. Research Methodology

The research methodology employed in this study adopts a comprehensive mixed-method approach to investigate the Product-as-a-Service (PaaS) circular business model thoroughly. This methodological framework combines qualitative and quantitative research techniques to ensure a robust analysis of both theoretical constructs and practical implementations (Abid, I, 2024).

4.1 Research Design

The study utilizes an exploratory sequential mixed-method design, which begins with qualitative data collection and analysis, followed by quantitative validation. This approach allows for a deep understanding of the PaaS implementation challenges and opportunities while providing measurable insights into their significance. The research design incorporates both inductive and deductive reasoning processes, enabling the development of theoretical frameworks grounded in empirical evidence. Figure 4 shows - 1) Qualitative Data Collection (Semi-structured interviews, Case studies, Document analysis), 2) Quantitative Data Collection (Surveys, Performance metrics analysis), 3) Data Analysis & Integration (Thematic analysis, Statistical analysis,

Triangulation) with bidirectional arrows showing iterative process and feedback loops between phases

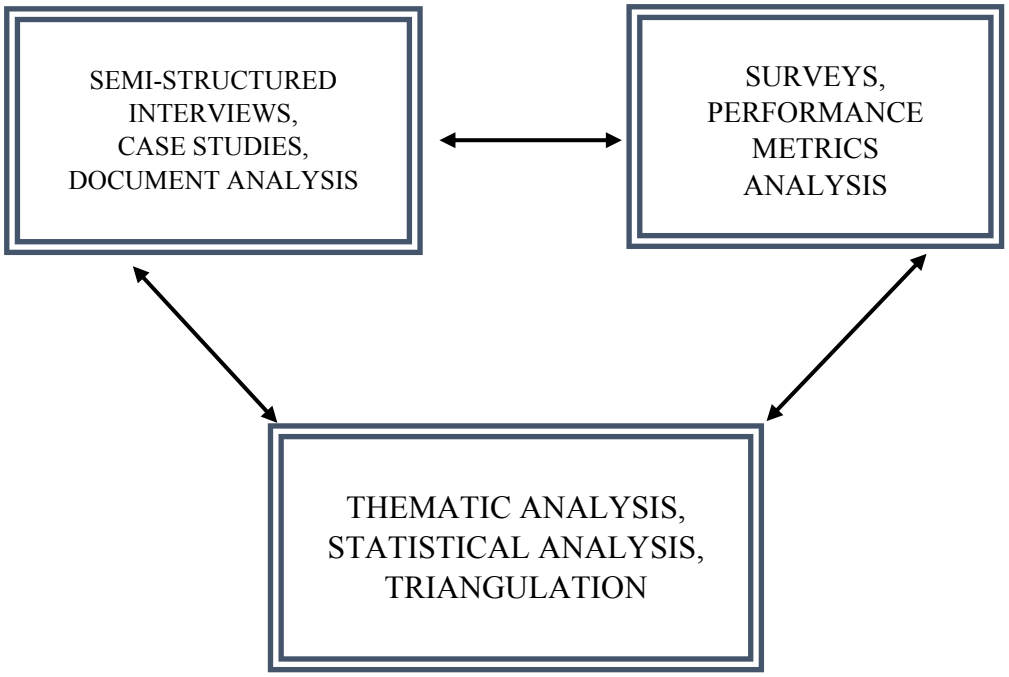

Figure 4: Three main phases Research Methodology

4.2 Validity and Reliability

To ensure research quality, several validation strategies are implemented. These include member checking for interview data, peer review of analysis procedures, and triangulation of multiple data sources. Reliability is maintained through detailed documentation of research procedures, consistent application of analytical protocols, and regular cross-checking of coding consistency.

4.3 Ethical Considerations

The research adheres to strict ethical guidelines, including informed consent from all participants, confidentiality agreements, and secure data storage protocols. All participants are provided with detailed information about the research objectives and their rights to withdraw at any time.

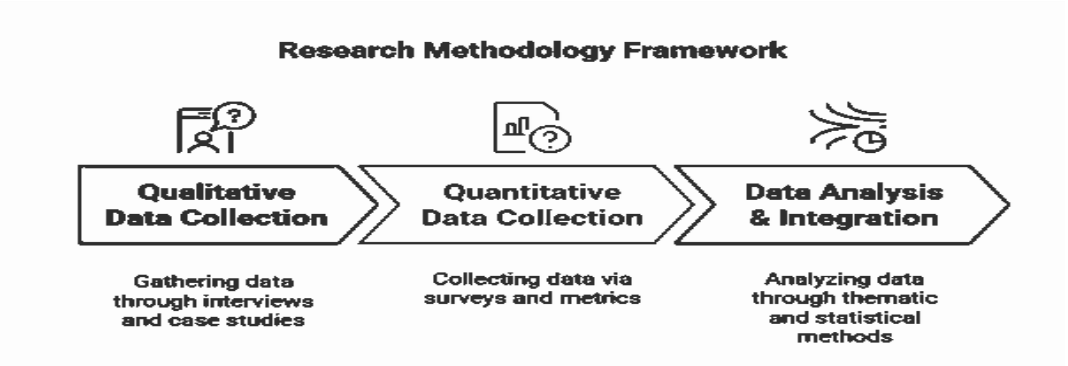

Figure 5: Research Methodology framework

4.4 Limitations and Boundaries

The study acknowledges certain methodological limitations, including potential geographical bias in data collection and the inherent challenges in generalizing findings across different industry contexts. These limitations are carefully documented and considered during data analysis and interpretation. This approach ensures that the study can effectively capture the complex dynamics of PaaS implementation while maintaining scientific validity and reliability.

5. Findings and Discussions

Based on the adopted methodology the collected data was analysed. The obtained results are discussed in the subsequent sections.

5.1 Digital Technology Integration

Integrating digital technologies has become a cornerstone in successfully implementing Product-as-a-Service (PaaS) business models, fundamentally transforming how companies deliver value and manage their assets (Zahran, B). This transformation is particularly evident in the convergence of Information Technology (IT) and Operational Technology (OT), which has created new opportunities for service innovation while simultaneously introducing novel challenges that need to be addressed.

5.2 Performance Monitoring Systems

The implementation of performance monitoring systems in PaaS models represents a critical advancement in how businesses track, analyze, and optimize their service offerings. Digital twins have emerged as a particularly powerful tool in this context, enabling real-time monitoring and predictive maintenance capabilities (Hunhevicz, J). These virtual replicas of physical products and systems allow companies to simulate, analyze, and optimize performance before implementing changes in the real world. Integrating digital twins with IoT sensors provides continuous data streams that enable predictive maintenance, reducing downtime and improving service reliability.

Smart contracts, implemented through blockchain technology, have revolutionized how service agreements are executed and monitored in PaaS systems. These self-executing contracts automatically enforce terms and conditions, ensuring transparency and reducing administrative overhead. The implementation of smart contracts has particularly benefited the manufacturing sector, where complex service agreements require precise tracking and verification of multiple parameters (Cuellar, D, 2022).

Real-time performance tracking systems have evolved to incorporate artificial intelligence and machine learning algorithms, enabling predictive analytics and automated decision-making processes. These systems can now anticipate potential failures, optimize maintenance schedules, and adjust service parameters based on usage patterns and environmental conditions. The integration of AI-driven analytics has significantly improved the accuracy of performance predictions and enhanced the overall efficiency of PaaS operations.

5.3 Data Security and Privacy

The increasing digitalization of PaaS models has brought data security and privacy to the forefront of implementation challenges. The convergence of IT and OT systems has created new vulnerabilities that require robust cybersecurity measures (Zahran, B, 2023). Protecting sensitive operational data, customer information, and proprietary service algorithms has become paramount in maintaining competitive advantage and ensuring regulatory compliance.

Blockchain technology has emerged as a crucial component in addressing security concerns, providing immutable records of transactions and secure data-sharing

mechanisms. Implementing distributed ledger technologies has enhanced transparency while maintaining data integrity across the service network. However, integrating blockchain solutions must carefully balance performance requirements and energy efficiency considerations.

The protection of IoT devices and sensors, which form the backbone of many PaaS implementations, requires specialized security protocols and regular updates to guard against emerging threats. The implementation of zero-trust architecture and end-to-end encryption has become standard practice in securing IoT networks and protecting sensitive operational data.

Privacy concerns in PaaS implementations extend beyond traditional data protection measures. The collection and analysis of usage data, while essential for service optimization, must be balanced with user privacy rights and regulatory requirements such as GDPR. Companies implementing PaaS models must develop comprehensive data governance frameworks that address both security and privacy concerns while maintaining service efficiency.

The integration of AI and machine learning in security systems has enabled more sophisticated threat detection and response capabilities. These systems can identify patterns indicative of security breaches and automatically implement countermeasures, reducing response times and minimizing potential damage. However, the use of AI in security applications also introduces new challenges related to algorithm transparency and accountability.

The success of PaaS implementations increasingly depends on the effective integration of these digital technologies while maintaining robust security measures. As the technology landscape continues to evolve, organizations must remain adaptable and proactive in addressing emerging security challenges while leveraging new opportunities for service innovation and optimization.

5.4 Economic Analysis:

5.4.1 Cost-Benefit Analysis

The transition from traditional ownership models to Product-as-a-Service (PaaS) necessitates a comprehensive evaluation of life-cycle costs and economic implications.

In the conventional ownership model, customers bear the full burden of initial purchase costs, maintenance expenses, and end-of-life disposal. However, PaaS fundamentally restructures this economic relationship by distributing costs and risks between service providers and users over extended periods (Hunhevicz, J, 2021).

The life-cycle cost analysis of PaaS reveals several distinctive economic characteristics that differentiate it from traditional ownership models. Service providers assume responsibility for asset maintenance, upgrades, and eventual disposal, while customers pay for access and performance rather than ownership. This arrangement creates a more predictable cost structure for customers while potentially generating higher lifetime revenue for providers through recurring service fees.

The economic viability of PaaS heavily depends on the provider's ability to optimize asset utilization and maintenance efficiency. By maintaining control over the product throughout its lifecycle, providers can implement preventive maintenance strategies, reducing unexpected downtime and repair costs. This approach enables more efficient resource allocation and potentially lower overall system costs compared to distributed ownership models. The initial capital requirements for PaaS providers are typically higher than traditional manufacturers, as they must finance and maintain a larger asset base. However, this investment can be offset by the steady revenue streams generated through service contracts and the potential for multiple use cycles of the same asset.

The economic benefits of PaaS extend beyond direct financial metrics to include reduced environmental externalities and improved resource efficiency. By incentivizing providers to design for durability and reparability, PaaS models can significantly lower the total cost of ownership while promoting sustainable resource use. The cost structure of PaaS also encourages innovation in product design and service delivery. Providers are motivated to develop more durable products with lower maintenance requirements, as they retain financial responsibility for product performance throughout the service period. This alignment of economic incentives with sustainability objectives represents a fundamental advantage of the PaaS model.

The financial risks associated with PaaS implementation require careful consideration. To ensure profitable service delivery, providers must accurately forecast maintenance costs, product lifespan, and customer usage patterns. The success of PaaS depends on sophisticated asset management systems and predictive maintenance capabilities to

optimize operational efficiency. The economic analysis must also account for the potential benefits of improved customer relationships and market differentiation. PaaS providers often develop deeper, longer-term customer relationships, leading to increased customer loyalty and reduced marketing costs. The ability to gather continuous feedback on product performance and customer needs can drive product innovation and service improvement, creating additional value streams.

The transition to PaaS may initially face resistance due to organizational inertia and established accounting practices. Traditional financial metrics and depreciation schedules may not adequately capture the value-creation potential of service-based business models. However, as environmental regulations tighten and resource costs increase, the economic advantages of PaaS become more pronounced. The cost-benefit analysis must consider the broader economic context, including regulatory trends, resource availability, and changing consumer preferences. The shift toward circular economy principles create favourable conditions for PaaS adoption as businesses seek to reduce resource consumption and environmental impact while maintaining profitability.

The economic viability of PaaS varies across different product categories and market segments. Products with high maintenance requirements, significant environmental impact, or rapid technological evolution may offer the most substantial economic case for servicization. The success of PaaS implementation depends on careful market analysis and strategic positioning to identify opportunities where service-based models can deliver superior value compared to traditional ownership.

5.4.2 Revenue Models

The revenue models associated with Product-as-a-Service (PaaS) represent a fundamental shift from traditional transaction-based sales to performance-based contracts and recurring revenue streams. Performance-based contracts in PaaS systems typically incorporate pricing components, including base subscription fees, usage-based charges, and performance incentives (Qiu, Y). This complex pricing structure enables providers to align revenue generation with value delivery while managing operational risks.

The design of effective pricing strategies requires careful consideration of customer needs, usage patterns, and competitive dynamics. Successful PaaS providers develop sophisticated pricing models that balance customer accessibility with sustainable profit margins. Usage-based pricing components can incentivize efficient resource utilization while ensuring fair compensation for service delivery. The revenue potential of PaaS models often exceeds traditional sales approaches due to the extended customer relationship and opportunity for value-added services. By maintaining ongoing customer engagement, providers can identify and capitalize on additional service opportunities throughout the product lifecycle. The predictability of recurring revenue streams can enhance business stability and facilitate long-term planning.

Performance-based contracts introduce new metrics for measuring business success, shifting focus from unit sales to customer satisfaction and service quality. These contracts often include service level agreements (SLAs) that specify performance targets and associated financial incentives or penalties. The ability to monitor and verify performance metrics becomes crucial for both providers and customers.

The revenue model must account for the costs of performance monitoring and reporting systems. The pricing strategy for PaaS offerings typically involves careful segmentation of customer groups based on usage patterns and service requirements. Different pricing tiers can accommodate varying levels of service intensity and customization needs. The flexibility to adjust pricing based on actual usage and performance helps optimize revenue generation while maintaining customer satisfaction.

The success of PaaS revenue models depends on effective risk management strategies. Providers must balance the potential for higher lifetime revenue against increased operational risks and capital requirements. Insurance mechanisms and risk-sharing arrangements may be necessary to protect both providers and customers. The revenue structure of PaaS can create opportunities for innovative financing arrangements. Performance-based contracts may attract external financing sources interested in predictable cash flows and sustainable business models. Demonstrating strong customer relationships and reliable service delivery can enhance access to capital markets.

The evolution of PaaS revenue models continues to drive innovation in pricing and contract structures. Advanced analytics and IoT technologies enable more sophisticated usage monitoring and dynamic pricing approaches. Integrating sustainability metrics into performance contracts reflects growing awareness of environmental considerations in business decision-making. The success of PaaS revenue models requires careful attention to customer acquisition and retention strategies. While initial customer acquisition costs may be higher than traditional sales models, the potential for long-term revenue streams justifies increased investment in customer relationships. Demonstrating clear value propositions and return on investment becomes crucial for customer retention.

The revenue potential of PaaS models extends beyond direct service fees to include data monetization opportunities. The continuous monitoring of product usage and performance generates valuable insights that can inform product development and service optimization. However, providers must carefully balance data monetization opportunities with privacy concerns and regulatory requirements.

The implementation of successful PaaS revenue models requires significant organizational transformation. Traditional sales and marketing approaches must evolve to support long-term service relationships rather than discrete transactions. Developing new capabilities in contract management, performance monitoring, and customer success becomes essential for sustainable revenue generation. The pricing strategies for PaaS offerings must consider the total ownership cost for providers and customers. Transparent pricing structures that clearly communicate value propositions help build trust and facilitate long-term relationships. The ability to demonstrate cost savings and performance improvements compared to traditional ownership models supports customer adoption and revenue growth.

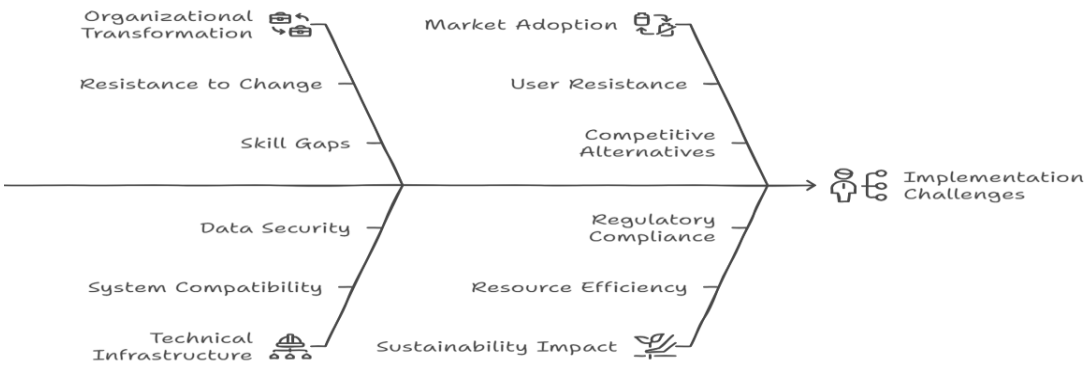

Figure 6: Framework for Implementation challenges

5.5 Organizational Transformation

The transition to a Product-as-a-Service (PaaS) business model presents significant organizational challenges that require fundamental changes in company structure, culture, and operations. Organizations face the complex task of restructuring their entire business framework to accommodate service-oriented delivery systems while maintaining operational efficiency. This transformation demands substantial modifications to existing organizational processes, requiring companies to develop new capabilities and competencies.

The shift from traditional product-centric operations to service-oriented delivery mechanisms necessitates a complete overhaul of organizational mindset and culture. Companies must address the challenge of retraining their workforce to adapt to new service-oriented roles, which often requires significant investment in human resource development and change management programs (Hunhevicz, J, 2021).

The transformation also impacts financial structures, as organizations must adjust to different revenue recognition patterns and cash flow cycles inherent in subscription-based models. This financial restructuring often creates temporary instability during the transition period, requiring careful management of stakeholder expectations and robust financial planning (Araujo, V, 2014).

Internal resistance to change represents another significant challenge, as employees and management may struggle to adapt to new operational paradigms and performance

metrics. Organizations must implement comprehensive change management strategies to address these concerns while maintaining productivity and employee morale.

The development of new organizational capabilities also requires significant investment in training and development programs, which can strain resources during the transition period. Companies must carefully balance the need for rapid transformation with the practical limitations of organizational change capacity. The establishment of new organizational processes and procedures necessitates careful coordination across different departments and functions, requiring enhanced communication and collaboration mechanisms. The transformation also impacts existing supplier relationships and supply chain operations, requiring careful management of partner expectations and potential restructuring of agreements.

Organizations must develop new metrics and performance indicators appropriate for service-based operations, which can be challenging to implement and monitor effectively. The integration of new service-oriented processes with existing product-focused operations requires careful planning and execution to minimize disruption to ongoing business activities. Companies must also address the challenge of maintaining quality standards while transitioning to service-based delivery models, requiring the development of new quality assurance frameworks and monitoring systems. The organizational transformation extends to customer relationship management, requiring new approaches to customer engagement and service delivery.

This transformation often necessitates the development of new organizational structures and reporting relationships to support service-oriented operations effectively. The challenge of maintaining organizational stability during the transition period requires careful balance between innovation and operational consistency. Companies must also address the impact on organizational culture, ensuring that new service-oriented values are effectively integrated into existing corporate culture. The transformation affects decision-making processes and governance structures, requiring new frameworks for strategic planning and operational management. Organizations must develop new competencies in service design and delivery while maintaining existing product-related capabilities. The challenge of managing this dual focus requires careful resource allocation and strategic planning.

5.6 Technical Infrastructure

The implementation of PaaS models requires robust technical infrastructure capable of supporting complex service delivery mechanisms. Organizations face significant challenges in developing and maintaining the necessary technical capabilities to support service-based operations effectively.

The technical infrastructure must accommodate real-time monitoring and data collection capabilities to track product usage and performance, requiring substantial investment in IoT technologies and data management systems. Security considerations present another critical challenge, as connected products and services require robust cybersecurity measures to protect both customer data and operational integrity. The integration of legacy systems with new service-oriented platforms often creates technical complications, requiring careful planning and execution to ensure seamless operations. Organizations must develop sophisticated data analytics capabilities to process and analyze the vast amount of usage data generated by service-based products.

The technical infrastructure must support multiple integration points with customer systems and third-party services, adding complexity to system architecture and maintenance requirements. Performance monitoring and optimization become critical challenges as organizations must ensure consistent service delivery across different platforms and user environments. The development of scalable technical solutions that can accommodate growing service demands while maintaining performance levels presents significant challenges. Organizations must address the technical requirements for real-time service delivery and support, including the development of robust communication networks and response systems.

The implementation of automated billing and subscription management systems requires sophisticated technical solutions capable of handling complex pricing models and usage-based charging. Technical infrastructure must support comprehensive product lifecycle management, including maintenance scheduling, performance monitoring, and end-of-life management. The challenge of maintaining system reliability and uptime becomes more critical in service-based models, requiring robust backup and disaster recovery systems. Organizations must develop technical

capabilities for remote product monitoring and management, including predictive maintenance and performance optimization features.

The integration of multiple technical systems and platforms requires careful attention to system architecture and interface design. Technical infrastructure must support complex customer relationship management systems capable of tracking service usage, customer interactions, and satisfaction levels. The development of user-friendly interfaces for both customers and service personnel presents significant technical challenges. Organizations must ensure technical systems can support various service delivery models while maintaining security and performance standards. The technical infrastructure must accommodate different deployment scenarios, including cloud-based, hybrid, and on-premises solutions.

5.7 Market Adoption

Market adoption of PaaS models presents unique challenges related to customer acceptance and market readiness. Organizations must address significant barriers to customer adoption, including concerns about long-term costs, service reliability, and loss of ownership control. The shift from traditional ownership models to service-based consumption requires substantial customer education and awareness building to demonstrate value proposition effectively. Market adoption challenges are particularly pronounced in industries with established ownership traditions, requiring careful market positioning and communication strategies.

Organizations must address customer concerns about data privacy and security in connected service models, which can significantly impact adoption rates. The development of appropriate pricing models that balance customer value with organizational profitability presents ongoing challenges in market adoption. Organizations must carefully manage the transition period where both traditional and service-based models may need to coexist to meet diverse market demands. The challenge of demonstrating clear value propositions to different customer segments requires sophisticated marketing and communication strategies.

Market adoption often requires significant investment in customer education and support systems to facilitate the transition to service-based consumption models. Organizations must address potential resistance from traditional sales channels and

develop new channel strategies appropriate for service-based offerings. The development of effective customer onboarding processes becomes critical to ensure successful adoption and long-term customer satisfaction. Market adoption challenges vary across different geographic regions and cultural contexts, requiring tailored approaches to market development.

Organizations must carefully manage customer expectations regarding service levels and performance standards to ensure successful adoption. The challenge of building trust in service-based relationships requires consistent delivery of value and reliable support systems. Market adoption often requires the development of new customer engagement models and support mechanisms. Organizations must address potential market concerns about vendor lock-in and service continuity in long-term service relationships.

The development of appropriate contract structures and service level agreements presents significant challenges in market adoption. Organizations must carefully balance the need for standardization with requirements for customization in service offerings. Market adoption challenges extend to regulatory compliance and legal considerations in different markets and jurisdictions.

5.8 Sustainability Impact

The Product-as-a-Service (PaaS) business model has emerged as a transformative approach to addressing global sustainability challenges, particularly in urban environments where resource consumption and environmental impacts are most concentrated (Muscillo, A, 2021). In today's context, where cities occupy merely 3% of Earth's surface yet account for 70% of global CO2 emissions and half of the world's waste production, the implementation of circular business models like PaaS has become increasingly critical.

The environmental benefits of PaaS manifest through multiple interconnected pathways. By shifting from ownership-based consumption to service-oriented access, PaaS fundamentally alters resource utilization patterns. This model enables more efficient use of products throughout their lifecycle, reducing the overall material footprint of consumption. The sustainability impact is particularly evident in the

reduction of raw material extraction and processing, as products remain in circulation for extended periods through maintenance, repair, and refurbishment cycles.

The circular economy contribution of PaaS extends beyond mere resource efficiency. By integrating sustainable development principles into its core operational framework, PaaS facilitates the transition toward a more regenerative economic system. This model addresses the fundamental challenges of sustainable consumption and production patterns by creating closed-loop systems where products are designed for durability, repairability, and eventual recycling. The resource efficiency gains through PaaS implementation are substantial. When products are managed as services, manufacturers have inherent incentives to maximize product longevity and minimize maintenance costs. This alignment of economic and environmental interests leads to improved product design, incorporating principles of durability and modularity. The result is a significant reduction in the environmental impact per unit of service delivered.

In the context of sustainable development goals, PaaS contributes to multiple objectives simultaneously. The model supports climate action by reducing carbon emissions associated with new product manufacturing. It promotes responsible consumption by optimizing resource use and minimizing waste generation. Furthermore, it facilitates sustainable cities and communities by enabling more efficient use of urban infrastructure and resources. The integration of artificial intelligence and digital technologies within PaaS systems has enhanced their sustainability impact. Smart monitoring systems enable predictive maintenance, optimizing product performance and extending operational lifespans. Data analytics help identify patterns of use and opportunities for efficiency improvements, further reducing environmental impacts.

The sustainability benefits of PaaS are particularly evident in industrial applications. In manufacturing sectors, the model has demonstrated significant reductions in energy consumption, waste generation, and carbon emissions. Companies implementing PaaS have reported improvements in resource productivity and substantial decreases in environmental footprint across their operations. However, the full realization of PaaS's sustainability potential requires careful consideration of system-wide impacts. This includes accounting for potential rebound effects, where improved efficiency might

lead to increased consumption, and ensuring that the environmental benefits of service-based models are not offset by increased transportation or logistics requirements.

Looking forward, the role of PaaS in advancing sustainable development will likely grow as cities continue to expand and resource pressures intensify. The model's ability to decouple economic growth from resource consumption positions it as a key strategy in achieving long-term sustainability objectives. As more organizations adopt PaaS approaches, the cumulative environmental benefits could contribute significantly to global sustainability targets and climate action goals.

The success of PaaS in delivering sustainability improvements depends on effective implementation strategies and supportive policy frameworks. Organizations must carefully design their service offerings to maximize environmental benefits while maintaining economic viability. This requires consideration of product lifecycle impacts, operational efficiency, and end-of-life management strategies. In conclusion, the sustainability impact of PaaS represents a significant advancement in circular economy implementation. Through its focus on resource efficiency, product longevity, and service-based consumption, the model offers a practical pathway toward more sustainable business practices. As environmental challenges continue to mount, the role of PaaS in facilitating sustainable development will become increasingly important, making it a crucial component of future economic systems.

6. Future Directions

6.1 Innovation Opportunities

The future of Product-as-a-Service (PaaS) models presents numerous opportunities for technological advancement and business model innovation. The integration of artificial intelligence and machine learning technologies has emerged as a crucial driver for enhancing PaaS offerings. These technologies enable predictive maintenance, optimize resource allocation, and improve service delivery efficiency. Smart sensors and Internet of Things (IoT) devices are increasingly being deployed to monitor product performance and usage patterns in real-time, allowing service providers to proactively address maintenance needs and enhance customer experience.

Blockchain technology presents another significant innovation opportunity for PaaS models. The implementation of smart contracts can automate service agreements, payment processes, and maintenance schedules, while ensuring transparency and trust between service providers and customers (Gan, W, 2023). This technology also enables the creation of digital product passports, which track the lifecycle of products and their components, facilitating more efficient circular economy practices.

The emergence of digital twins technology represents a transformative opportunity for PaaS providers. By creating virtual replicas of physical products, companies can simulate performance, predict maintenance requirements, and optimize service delivery. This technology enables providers to better understand product usage patterns and implement more effective servitization strategies. The integration of augmented reality (AR) and virtual reality (VR) technologies further enhances the service experience by providing remote maintenance support and training.

Advanced materials and manufacturing technologies are revolutionizing product design for PaaS models. The development of more durable, modular, and easily repairable products supports the circular economy principles inherent in PaaS offerings. These innovations enable products to maintain their value over multiple use cycles while reducing maintenance costs and environmental impact.

The evolution of customer relationship management (CRM) systems, powered by artificial intelligence, enables PaaS providers to better understand and predict customer needs. These systems analyze usage patterns, maintenance history, and customer feedback to deliver personalized services and improve customer satisfaction (Gan, W, 2023). The integration of social media analytics and sentiment analysis provides additional insights into customer preferences and behavior patterns.

Data analytics and machine learning algorithms are becoming increasingly sophisticated in optimizing pricing strategies for PaaS offerings. These technologies enable dynamic pricing models that reflect actual product usage, maintenance costs, and market conditions. The development of more accurate predictive models helps providers better manage risks and maintain profitable operations while delivering value to customers.

The convergence of edge computing and 5G networks creates new possibilities for PaaS implementations. These technologies enable real-time monitoring and control of products in the field, reducing latency and improving service response times. The increased connectivity and processing capabilities at the edge support more sophisticated service offerings and enhanced customer experiences.

Innovation in financial technology (FinTech) solutions supports the development of more flexible payment models for PaaS offerings. The integration of micropayment systems and usage-based billing platforms enables providers to offer more granular and customized pricing options (Gan, W, 2023). These innovations make PaaS more accessible to a broader range of customers while improving financial sustainability for providers.

The development of circular supply chain networks, supported by digital platforms, enables more efficient resource management and product lifecycle optimization. These networks facilitate the tracking and recovery of products and materials, supporting the transition to a more circular economy. The integration of artificial intelligence optimizes logistics operations and reduces environmental impact.

Emerging technologies in material science and recycling present opportunities for improving product sustainability and end-of-life management. Advanced recycling technologies and bio-based materials support the development of more environmentally friendly products suitable for PaaS models. These innovations help reduce waste and support the circular economy objectives of PaaS offerings.

6.2 Policy Framework

The development of comprehensive policy frameworks is essential for supporting the growth and sustainability of Product-as-a-Service (PaaS) business models. Regulatory requirements must evolve to address the unique challenges and opportunities presented by these innovative service-based approaches. The establishment of clear legal frameworks for product ownership, liability, and end-of-life management is crucial for creating a stable operating environment for PaaS providers.

Environmental regulations play a critical role in shaping the future of PaaS models. Policies promoting extended producer responsibility (EPR) and circular economy principles create incentives for companies to adopt service-based business models.

These regulations should be designed to encourage product longevity, repairability, and recyclability while maintaining fair competition in the market.

Tax policies need to be adapted to better support PaaS business models. The current tax systems, primarily designed for traditional ownership-based models, may need modification to accommodate service-based revenue streams. This includes considerations for depreciation, value-added tax treatment, and incentives for circular economy practices.

Standardization of product design and service delivery metrics is essential for ensuring quality and compatibility across PaaS offerings. Policy frameworks should promote the development of industry standards for product durability, maintenance procedures, and performance metrics. These standards facilitate market transparency and enable more effective comparison of service offerings.

Data protection and privacy regulations must be strengthened to address the increasing collection and use of customer data in PaaS models. Policies should balance the need for data-driven service optimization with consumer privacy rights. Clear guidelines for data collection, storage, and usage are essential for maintaining customer trust and compliance.

Consumer protection policies need to evolve to address the unique aspects of service-based consumption models. Regulations should ensure fair contract terms, transparent pricing, and adequate service level guarantees. These policies must also consider the long-term implications of shifting from ownership to access-based consumption.

Financial regulations should be updated to support the development of innovative financing models for PaaS offerings. Policies need to address issues such as asset valuation, revenue recognition, and risk assessment for service-based business models. Clear guidelines for financial reporting and accounting practices are essential for attracting investment and maintaining market stability.

Labor policies must adapt to support the workforce transitions associated with PaaS models. Regulations should address skills development, worker protection, and employment conditions in service-based business models. These policies should promote fair labor practices while supporting the development of new service-related job opportunities.

International trade policies need to consider the implications of PaaS models for global commerce. Regulations should address issues such as cross-border service provision, product standards harmonization, and intellectual property protection. These policies must balance national interests with the need for international cooperation in developing circular economy solutions.

Infrastructure development policies should support the digital and physical requirements of PaaS models. Regulations should promote investment in communication networks, logistics infrastructure, and recycling facilities. These policies are essential for creating the enabling environment necessary for successful PaaS implementation.

The development of monitoring and enforcement mechanisms is crucial for ensuring compliance with PaaS-related regulations. Policies should establish clear responsibilities for oversight and provide adequate resources for enforcement. Regular review and updating of regulatory frameworks is essential for addressing emerging challenges and opportunities in the PaaS sector.

Public procurement policies should be adapted to facilitate the adoption of PaaS models by government agencies. Regulations should enable public sector organizations to transition from traditional purchasing to service-based consumption models. These policies can help drive market development and demonstrate the viability of PaaS approaches.

7. Conclusion

In this comprehensive exploration of the Product-as-a-Service (PaaS) circular business model, our research has yielded significant insights into both the transformative potential and inherent challenges of this innovative approach (Russell, J, 2025). The findings demonstrate that PaaS represents a fundamental shift in how businesses conceptualize value creation and delivery, moving beyond traditional product-centric models to embrace service-oriented solutions that promote sustainability and resource efficiency.

Our analysis reveals that successful PaaS implementation requires a carefully orchestrated transformation across multiple organizational dimensions. The transition

demands substantial changes in organizational structure, operational processes, and strategic planning frameworks. Companies that have successfully implemented PaaS models demonstrate enhanced resource utilization, reduced environmental impact, and improved customer relationships through continuous engagement and value delivery.

The research has identified several critical success factors for PaaS implementation. First, the development of robust digital infrastructure emerges as a fundamental requirement, enabling real-time monitoring, predictive maintenance, and efficient service delivery (Russell, J, 2025). Second, the establishment of circular supply chains and reverse logistics systems proves essential for managing product lifecycles effectively. Third, the cultivation of strong customer relationships through transparent communication and value proposition alignment significantly influences adoption success.

The economic viability of PaaS models has been demonstrated through multiple case studies, showing potential for both revenue stability and long-term profitability. However, this transition requires significant initial investment and a fundamental restructuring of financial models. The shift from one-time sales to recurring revenue streams necessitates careful cash flow management and adjusted performance metrics. Our findings indicate that PaaS models contribute significantly to environmental sustainability objectives. Through optimized resource utilization and extended product lifecycles, organizations have achieved measurable reductions in waste generation and carbon emissions. The model's emphasis on product longevity and maintenance has fostered innovation in product design, promoting modularity and repairability.

Consumer behavior analysis reveals evolving attitudes toward ownership and service consumption. The research indicates a growing acceptance of access-based consumption models, particularly among younger demographics (Russell, J, 2025). This shift in consumer preferences aligns with broader societal trends toward sustainability and minimalism, suggesting favorable conditions for PaaS adoption.

The implementation challenges identified through our research require careful consideration. Technical challenges include the need for sophisticated monitoring systems and maintenance infrastructure. Organizational challenges encompass the requirement for new capabilities and cultural transformation. Financial challenges involve managing the transition period and securing appropriate funding mechanisms.

Looking forward, the research suggests several promising directions for PaaS evolution. The integration of emerging technologies, such as artificial intelligence and blockchain, presents opportunities for enhanced service delivery and transparency. The potential for cross-industry collaboration and standardization could accelerate adoption and scale benefits.

For practitioners considering PaaS adoption, our research provides a structured framework for implementation. Success requires a phased approach, beginning with pilot programs and scaling based on learned experiences. The importance of stakeholder engagement, particularly with customers and supply chain partners, cannot be overstated. The research contributes to the broader discourse on circular economy transitions by demonstrating how PaaS models can serve as practical mechanisms for implementing circular principles. The findings suggest that PaaS represents not merely a business model innovation but a fundamental shift in how value is created and delivered in a resource-constrained world.

Regulatory frameworks and policy support emerge as critical enablers for PaaS adoption. Our analysis indicates that supportive policy environments, particularly regarding extended producer responsibility and circular economy initiatives, can accelerate market transformation. The development of industry standards and certification systems could further facilitate adoption and ensure quality service delivery. The implications for business strategy are profound, suggesting the need for organizations to reassess their core competencies and value propositions. Success in PaaS implementation requires the development of new capabilities in service design, customer relationship management, and lifecycle optimization. Organizations must also cultivate innovation capabilities to continuously improve service offerings and operational efficiency.

Our research highlights the importance of ecosystem thinking in PaaS implementation. Successful models often involve collaboration across value chains, including partnerships with technology providers, maintenance services, and end-of-life management specialists. This ecosystem approach enables comprehensive solutions while distributing risks and investments among partners. The findings emphasize the role of data and analytics in driving successful PaaS operations. Real-time monitoring, predictive maintenance, and usage pattern analysis enable optimization of service

delivery and resource utilization. The ability to leverage data insights emerges as a critical competitive advantage in PaaS markets.

In conclusion, our research demonstrates that PaaS represents a viable and increasingly important business model for organizations seeking to combine commercial success with environmental responsibility. While challenges exist, the potential benefits in terms of resource efficiency, customer relationships, and sustainable value creation justify the transition effort. The model's alignment with circular economy principles and evolving consumer preferences suggests continued growth and evolution in the coming years.

The success of PaaS implementation ultimately depends on organizations' ability to execute comprehensive transformation strategies while maintaining focus on customer value creation. As markets continue to evolve and technology capabilities advance, PaaS models are likely to become increasingly sophisticated and widespread. This evolution will require ongoing research and practical experimentation to fully realize the model's potential for sustainable business transformation.

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Examining the Role of Privacy Policies in Online Personal Information Sharing

Dr. Fatin[1]

Joyce Petricia B[2]

Neha U[1]

Abstract

As digital platforms increasingly collect and utilize user data, understanding how privacy policies influence information disclosure behaviours becomes crucial. This study studies the bearing of privacy policies on users' decisions to share personal information online. This study employed a survey-based research design to collect data from 54 internet users representing diverse demographic backgrounds. The responses were analysed to understand patterns and trends in user behaviour. Results indicate that clear, concise, and easily accessible privacy policies positively correlate with users' willingness to share personal information. However, the study also reveals a significant gap between policy comprehension and actual user behaviour, with many participants admitting to sharing information without thoroughly reading policies. Furthermore, we identified key factors that influence users' trust in privacy policies, including Usage of Digital Platforms, Privacy Policy Awareness, Perceptions and Concerns, Trust and Transparency, Impact of Privacy Policies, Data Protection Measures, Awareness of Data Usage, Informed Consent, Impact of Data Breaches, Legal Rights and Recourse, Educational Initiatives, Use of Privacy Tools. This research contributes new evidence to ongoing discussions in digital privacy and offer practical implications for policymakers and online platform developers in designing effective privacy protection measures.

Keywords: Privacy Policies, Data Protection, User Trust, Information Disclosure and Online User Behaviour

[1]PG Department of Commerce, St. Claret College Autonomous, Bengaluru. India.
[2]Department of Commerce & Management, Vidhya Shekar Institution of Management Studies. Bangalore. India

1. Introduction

In today's interconnected world, the digital world has become a vital part of our daily lives, facilitating communication, global business, and social ties. As a result of this digital revolution, privacy laws, digital privacy, and the sharing of personal information online have all grown to be significant concerns. While technology advancements have numerous advantages, there are risks and challenges as well that need to be carefully examined in order to protect people's confidentiality and personal data.

Digital privacy is the protection of individuals' private information, communications, and online activities in the digital realm. It encompasses people's autonomy over the gathering, use, and dissemination of their personal data when utilizing digital platforms, services, and gadgets such as computers, smartphones, social media, websites, and applications. Digital privacy involves preventing companies, governments, hackers, and other bad actors from illegally accessing, monitoring, and misusing sensitive data, such as financial information, health records, browser history, location data, and communication exchanges.

The capacity to control one's personal information and online conduct while shielding it from abuse, unauthorized access, and surveillance is known as digital privacy. However, privacy policies serve as legal documents that outline how companies collect, use, and protect personal information while also alerting consumers to their rights and responsibilities regarding privacy protection. Personal information sharing online, on the other hand, refers to people freely disclosing private information on digital platforms like social media networks and e-commerce websites.

Data protection, consent and control, anonymity and pseudonymity, encryption and security, and privacy policies and regulations are all important aspects of online privacy. Maintaining people's digital privacy is essential to upholding their autonomy, dignity, and fundamental rights in the increasingly interconnected and data-driven digital world. It calls for finding a balance between advancing cutting-edge technologies and protecting individuals' right to privacy and individual freedom.

The way people connect, communicate, and share information has changed dramatically as a result of the widespread use of the internet. People's increased use of

digital platforms frequently results in the unintentional exposure of enormous volumes of personal data, which raises serious privacy and security concerns. This study looks at how important privacy policies are for sharing personal information online and how they affect user behaviour and perceptions regarding their data's safety.

Privacy policies are crucial instruments that define how companies collect, use, and protect personal data. In the Indian context, they are not merely legal formalities but essential mechanisms for building trust between digital service providers and users. With the enactment of the Digital Personal Data Protection Act, 2023 (DPDPA), along with the Information Technology Act, 2000 and the IT Rules, 2011, organizations are required to ensure transparency in their data collection and processing practices. These laws mandate that companies clearly state what personal data is collected, the purposes for which it is used, and any sharing with third parties. Such transparency enables individuals to make informed choices about their online activities and strengthens accountability among organizations handling personal data. As India's digital ecosystem grows rapidly, privacy policies play a central role in upholding user rights and responsible data governance.

Furthermore, privacy regulations have a big influence on user behaviour and are beneficial in ways that go beyond simple compliance. Research shows that by reducing worries about possible misuse, well-written privacy policies can increase users' willingness to divulge personal information. On the other hand, unclear or unduly complicated policies could discourage consumers from using a platform because they are concerned about privacy infringement. This contradiction emphasizes how important it is for businesses to create privacy rules that are understandable, succinct, and align with users' privacy ideals.

Privacy regulations not only influence behaviour and build trust, but they also mirror broader society views on data privacy. People now frequently value convenience over privacy as a result of the cultural shift brought about by the growth of social media and internet services.

However, the need for strong privacy measures is increasing as stories about data breaches and misuse keep making the news. Users are calling for more control over their personal data as they become more conscious of their rights. By taking user

feedback into account and adjusting to new developments in data protection, privacy policies must change to satisfy these shifting expectations.

This paper will conclude by examining the complex role that privacy policies play in the sharing of personal information online. Our goal is to offer a thorough grasp of how these rules influence the digital environment by looking at how they affect user behaviour, trust, and public perceptions of privacy. We hope that this investigation will highlight effective practices for businesses looking to improve their privacy policies while protecting the interests of users in an increasingly interconnected world.

Privacy policies tell clients about their rights with relation to their personal data like name, address, email address, phone numbers, login information, social media information, or payment card number, including how to access, edit, or remove it. In the current digital environment, when consumers are demanding more control over their information, this empowerment is essential. According to studies, 88% of users are more inclined to share personal information with businesses they trust, therefore this dedication might increase client loyalty. On the other hand, ambiguity can discourage potential clients and breed mistrust.

For a number of reasons, including operational integrity, consumer trust, and regulatory compliance, businesses and websites must have an online privacy policy. Data Security Council of India (DSCI)

2. Review of Literature

Complexity and legal jargon in privacy policies discourage users from understanding them, thereby reducing the effectiveness of such policies in promoting informed data-sharing decisions (Wilson, T., & Heisenberg, M., 2019). Heightened privacy concerns can deter users from sharing personal information online; however, explicit assurances provided in privacy policies may help alleviate these concerns to some extent (Acquisti et al., 2015). Transparent privacy policies enhance user trust, as companies that clearly outline their data usage and protection practices are more likely to build and maintain loyal user bases (Beldad, A., et al. 2018). Privacy assurances in terms of policy clarity and control mechanisms influence users' willingness to share personal data, showing a correlation between transparency and higher disclosure rates (Tsai , J.Y., et al., 2017).

Personalized privacy settings empower users by offering greater control over their data-sharing practices, which aligns with individual preferences and enhances both satisfaction and trust (Gonzalez, C., & Martens, B., 2020). Organizations' adherence to regulatory frameworks significantly influences user perception of privacy policies, encouraging more responsible data-sharing behaviours (Greenleaf, G., 2019). Users who perceive higher risks in sharing personal information online tend to rely on robust privacy policies for reassurance and confidence in data-sharing decisions (Dinev, T., & Hart, P., 2016).

Cultural norms influence how privacy policies are interpreted and trusted, with collectivist cultures often placing greater emphasis on communal rather than individual privacy (Hofstede, G., et al., 2015). Simpler and visually appealing privacy policies enhance user engagement and comprehension, helping reduce ambiguity around data-sharing practices (Kincaid, J. P., et al. 2018). Excessively lengthy privacy policies discourage users from reading them, thereby undermining their effectiveness in supporting informed data-sharing decisions (Obar & Oeldorf-Hirsch, 2020). Interactive, gamified approaches to explaining privacy policies can enhance user engagement and comprehension, leading to more informed and responsible data-sharing behaviour (Kaptelinin, V., & Nardi, B. A., 2017).

Privacy policies of social media platforms play a crucial role in shaping user behaviour, with transparency regarding data use and third-party sharing being vital for maintaining user trust and retention (Boyd, D., & Ellison, N., 2018). Poorly implemented privacy policies can erode user trust and expose organizations to legal risks, thereby influencing their overall approach to online data governance (Warren, S. D., & Brandeis, L. D., 2019).

Privacy policies that incorporate behavioural nudges can effectively guide users toward more privacy-conscious decisions while preserving their autonomy (Thaler, R. H., & Sunstein, C. R., 2017). Privacy policies significantly influence consumer trust and purchasing behaviour on e-commerce platforms, highlighting their importance in mitigating perceived privacy risks (Gefen, D., Karahanna, E., & Straub, D. W., 2018). A review of information privacy literature in Information Systems (IS) highlights the increasing relevance of privacy in the digital era, identifying research gaps such as limited focus on diverse populations and overrepresentation of U.S.-centric studies,

and calls for broader, more inclusive investigations across varied demographics and international contexts (Bélanger, F., & Crossler, R. E., 2011).

Information privacy is gaining increasing importance in the field of Information Systems, with existing research showing notable gaps; broader studies involving diverse demographics and practical applications are needed to better inform policy and system design (Bélanger, F., & Crossler, R. E., 2011).

3. Objectives

This study explores how the perceived effectiveness of privacy policies influences users' awareness of how their personal data is used, particularly in targeted advertising. It also examines whether clear and adequate information in these policies reduces concerns about data misuse. Additionally, the study investigates how the level of privacy control available to users impacts their frequency of using digital platforms. So the objectives of the study are:

1. To examine the link between privacy policy effectiveness and awareness of personal data use in targeted advertising.
2. To analyze the link between privacy policy effectiveness and adequacy of personal data usage information.
3. To examine the association between the perceived effectiveness of privacy policies and concerns about personal data misuse.
4. To identify the association privacy control and digital platform usage frequency.

4. Hypothesis of the Study

Based the above stated research objectives four set of hypothesis were developed. These hypotheses guided the further research work.

H_{01}: There is no significant association between the perceived effectiveness of privacy policies in protecting personal data and the level of awareness of how personal data is used for targeted advertising.

H_{a1}: There is a significant association between the perceived effectiveness of privacy policies in protecting personal data and the level of awareness of how personal data is used for targeted advertising.

H_{02}: There is no significant association between the perception of the effectiveness of privacy policies in protecting individuals and the adequacy of information provided regarding the use of personal data.

H_{a2}: There is a significant association between the perception of the effectiveness of privacy policies in protecting individuals and the adequacy of information provided regarding the use of personal data.

H_{03}: There is no significant association between the perceived effectiveness of privacy policies and concerns about the possibility of personal data misuse.

H_{a3}: There is a significant association between the perceived effectiveness of privacy policies and concerns about the possibility of personal data misuse.

H_{04}: There is no significant association between the importance of having control over who can access personal information and the frequency of digital platform usage.

H_{a4}: There is a significant association between the importance of having control over who can access personal information and the frequency of digital platform usage.

5. Research methodology

The study adopts a quantitative, cross-sectional survey design to examine the associations between perceptions of privacy policy effectiveness and various factors related to personal data awareness, adequacy of information, concern about data misuse, and control over personal data. The target population comprises digital platform users aged 18 and above, who actively engage with online services where personal data is collected and used for targeted advertising. A non-probability purposive sampling technique was employed to reach respondents who are familiar with privacy policies and digital platforms. A sample of 54 respondents was collected using online survey tools. Primary data was gathered through a structured questionnaire comprising closed-ended items using categorical options. The questionnaire consisted of sections covering: Perceived effectiveness of privacy

policies, awareness of personal data use in targeted advertising, adequacy of information regarding data use, concerns about personal data misuse, perceived control over personal information and frequency of digital platform usage. The data was analyzed using descriptive and inferential statistics with the help of SPSS software. To test the hypotheses Chi-square test of independence was applied to examine the associations between categorical variables (e.g., perceived effectiveness vs. awareness, adequacy of information, concern, and control). This study focuses on 54 respondents from Bangalore who use digital platforms. It aims to understand how they view the effectiveness of privacy policies and their awareness of how personal data is used. Since the sample is small and limited to one city, the findings reflect local user perspectives and may not apply to a wider population.

6. Data Analysis and Discussions of the study

Once the data is collected it was analysed on SPSS software. Finding from such quantitative analysis uncovered various inferences about the population under study. The same is shown as table 1.

Table 1: Demographic Profile of the Respondents

Variables		Frequency	Valid %	Cumulative %
Gender	Male	8	14.8	14.8
	Female	46	85.2	100.0
Total		54	100.0	
Occupation	Student	26	48	48
	Teacher	17	31	79
	House Maker	3	6	85
	Working	8	15	100.0
Total		54	100.0	
Education	PUC	2	4	4
	B. Com	19	35	39
	M. Com/ M. BA/ M. Sc	31	57	96
	Ph. D	2	4	100.0
Total		54	100.0	
Frequency of Usage	Daily	43	80	80

	Once a Week	3	5	85
	Several times a week	7	13	98
	Rarely	1	2	100.0
Total		54	100.0	
Type of Personal Information shared online	Name	38	70	
	Birthdate	17	32	
	Email Address	37	69	
	Phone Number	27	50	
	Photos or Videos	17	32	
Reading Privacy Policies before sharing personal information on websites or platforms	Yes, sometimes	29	53	53
	No, never	5	9	62
	Yes, always	20	38	100.0
Total		54	100.0	
Importance of presence of privacy policies before sharing personal Information	Not important	2	4	4
	Somewhat important	12	22	26
	Very important	40	74	100
Total		54	100.0	
Awareness of Personal Data usage for Targeting	Not Aware	2	4	4
	Somewhat aware	30	56	60
	Fully aware	22	40	100
Total		54	100.0	

The survey exposes that the majority of respondents are female (85.2%) and predominantly students (48%), with a significant proportion holding postgraduate degrees (57%). Most participants use the internet daily (80%) and frequently share personal information online, such as names (70%), email addresses (69%), and phone numbers (50%). While 53% sometimes read privacy policies before sharing information, 9% never do, despite 74% considering privacy policies very important. This highlights a gap between awareness of privacy importance and actual behavior in reading and understanding privacy terms.

The analysis suggests that individuals who perceive privacy policies as effective tend to have a higher level of awareness about how their personal data is used for targeted advertising. In contrast, those who do not believe in the effectiveness of privacy

policies have varying levels of awareness, but a significant portion of them still report being somewhat aware of how their data is used.

Table 2: Cross Tabulation of Privacy Policy Effectiveness vs. Awareness of Data Use in Targeted Ads

Effective Privacy policies in protection	Somewhat aware	Fully aware	Not aware	Total
Yes	14	16	0	30
No	16	6	2	24
Total	30	22	2	54

Pearson Chi-Square 6.087[a] Sig Value 0.048

The significant p-value (0.048) indicates that the relationship between these two factors is not due to chance, implying that people's perception of privacy policies' effectiveness may influence their awareness about data usage for targeted advertising.

Table 3: Crosstabulation of Privacy Policy Effectiveness and Information Adequacy

Perception of effectiveness of privacy policies	Adequately Informed	Not Adequately Informed	Total
Yes	28	2	30
No	12	12	24
Total	40	14	54

Pearson Chi-Square 13.037[a] Sig Value 0.000

The crosstabulation reveals a significant relationship between individuals' perceptions of the effectiveness of privacy policies and their feelings of being adequately informed about how their personal data is used. The Pearson Chi-Square value of 13.037 with a significance value of 0.000 indicates a strong association between the two variables. Specifically, individuals who believe privacy policies are effective tend to feel adequately informed, while those who do not believe in the effectiveness of privacy policies are more diverse. This significant result suggests that perceptions of privacy policy effectiveness influence individuals' sense of being informed about data usage.

Table 4: Cross-tabulation of Perceived Effectiveness of Privacy Policies and Concerns About Personal Data Misuse

Effectiveness of Privacy Policies	Not Concerned About the Possibility of Your Personal Data Being Misused	Somewhat Concerned About the Possibility of Your Personal Data Being Misused	Very Concerned About the Possibility of Your Personal Data Being Misused	Total
Yes	0	8	22	30
No	1	14	9	24
Total	1	22	31	54

Pearson Chi-Square 7.514[a] Sig Value 0.023

Table 5: Cross-tabulation of Privacy Control Importance and Platform Usage Frequency

Importance of control over access to personal information	frequency of digital platform usage				Total
	Rarely	Once a week	Several times a week	Daily	
Not important at all	1	0	0	0	1
Slightly important	0	0	0	2	2
Moderately important	0	5	1	1	7
Very important	0	19	2	1	22
Extremely important	0	19	0	3	22
Total	1	43	3	7	54

Pearson Chi-Square 38.003[a] Sig Value 0.000

The cross-tabulation between the perceived effectiveness of privacy policies and concerns about personal data misuse shows a significant relationship. Respondents who believe privacy policies are effective tend to express higher concern about data misuse, particularly being very concerned. In contrast, those who feel privacy policies are ineffective have a more varied distribution of concern levels. The Pearson Chi-Square test value of 7.514 with a p-value of 0.023, indicates that the relationship

between these two variables is statistically significant, suggesting that individuals who perceive privacy policies as effective are more likely to be very concerned about the misuse of their personal data.

Table 6 Summary of Hypotheses Tested and Results

	Hypotheses	Chi Square Value	P-Value	Accepted /Rejected
H_{01}	There is no significant association between the perceived effectiveness of privacy policies in protecting personal data and the level of awareness of how personal data is used for targeted advertising.	6.087[a]	0.048	Rejected
H_{02}	There is no significant association between the perception of the effectiveness of privacy policies in protecting individuals and the adequacy of information provided regarding the use of personal data.	13.037[a]	0.000	Rejected
H_{03}	There is no significant association between the perceived effectiveness of privacy policies and concerns about the possibility of personal data misuse.	7.514[a]	0.023	Rejected
H_{04}	There is no significant association between the importance of having control over who can access personal information and the frequency of digital platform usage.	38.003[a]	0.000	Rejected

The cross-tabulation shows the relationship between the significance of having control over personal information and the frequency of digital platform usage. The majority of respondents who consider control over personal information as "Extremely important" or "Very important" tend to use digital platforms either daily, several times

a week, or once a week, with the highest concentration among weekly users. Those who view control as "Moderately important" have a more even distribution across usage frequencies, while respondents who consider it "Not important at all" or "Slightly important" are minimal and rare users of digital platforms.

The Pearson Chi-Square value of 38.003 by a significance value ($p = 0.000$) indicates a highly significant relationship between the perceived importance of control over personal information and the frequency of digital platform usage. This suggests that individuals who assign greater importance to controlling access to their personal information are more likely to be frequent users of digital platforms, while those who assign little importance to this control tend to use digital platforms less frequently.

7. Practical Implications

This study has several important implications. It shows that many users are not fully aware of how their personal data is used for targeted advertising. This suggests that digital platforms need to make their privacy policies clearer and easier to understand. Companies that collect and use personal data should focus on being more transparent to build trust with their users. The results also suggest that rules and guidelines related to data privacy could be improved to help protect users better. For researchers, the study provides a base for future research on how people view privacy across different groups and platforms. On a social level, the findings highlight the importance of digital awareness and helping people feel more in control of their personal information in today's online world.

8. Findings and Conclusion

The findings of the study indicate significant relationships between individuals' perceptions of privacy policy effectiveness and various factors related to personal data usage and online behavior. Specifically, the perceived effectiveness of privacy policies in protecting personal data is significantly associated with the level of awareness individuals have regarding how their personal data is utilized for targeted advertising. Moreover, there is a significant link between the effectiveness of privacy policies and the adequacy of information provided to users about the use of their personal data. The study also highlights that concerns about personal data misuse are closely tied to

perceptions of privacy policy effectiveness. Individuals who place high importance on controlling access to their personal information tend to be more active on digital platforms. These results emphasize the critical role that effective, transparent privacy policies play in building user awareness, addressing concerns about data misuse, and encouraging informed interactions with digital platforms. This understanding can inform the design of privacy policies that not only enhance user protection but also promote a greater sense of trust and security among users.

Based on the findings of the study, digital platforms should prioritize making their privacy policies clearer and more transparent, especially when it comes to explaining how personal data is used, particularly for targeted advertising. This would help users understand exactly how their data is being utilized, which in turn can reduce any uncertainties they may have. Additionally, platforms should offer users more control over who can access their personal information, as this would not only increase their sense of security but also encourage them to engage with the platform more frequently. Strengthening privacy policies to better safeguard personal data is crucial in alleviating concerns about potential misuse, which is a key factor in fostering trust between users and platforms. Furthermore, platforms could launch educational campaigns to raise awareness about data management options, such as settings that allow users to control their information and how it is shared. Ensuring that personal data is protected and users' privacy is respected will create a safer and more trustworthy online environment. These combined efforts would not only help build trust with users but also motivate them to use digital services more often, knowing that their data is being handled responsibly.

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Management Through Trust Building --- A New Journey Ahead

Prof. (Dr.) Tridib Chakraborrti[1]

"Trust Begets Trust...Distrust Begets Distrust"

"Trust cannot be demanded. It has to be earned"

1. Introduction

TODAY. It is no denying a fact that we are living a highly complex and dynamic society. In fact, society is getting complex day by day, composed of a large variety of subsystems such as families, friendship groups, working groups, professional groups and other more or less organised collectivities of individuals The greatest challenges before us is to keep track with this rapidly changing society maintaining good relationship with these diverse groups of people.

2. The Psychology of togetherness

Thousands years ago, the great Greek philosopher Aristotle wrote" Man is a Social Animal " In fact, each of us needs other people. True it is also that people join together not only to survive, but also to fulfill their human strivings. Quite obviously, we need to feel close to one person, such as a parent, spouse or friend and we also always need companionship of other persons. Therefore, it has been rightly stated that a well-rounded life includes both types of relationships. It has been found that we babied together in families to procreate and preserve human life There is an interpersonal relationship between all the members of the family at different times and different levels.

We also cooperate with others to satisfy a wide range of needs and to attain mental goals. We depend on the services of variety of community organizations such as hospitals, police and other police service organizations. But the fact remains that as the society is getting complex day and we are slowly but steadily moving towards

[1]Formerly of IIM Calcutta, the Author is currently an independent Management Consultant & HR Trainer cum Motivational Speaker

digital based society, the common people are also getting dependent more fully on police services to satisfy their needs for security. This growing dependence certainly calls for a trusting relationships between the two i.e., police forces on the one hand and the common people of the society on the other.

3. Trust, --A Conceptual Spadework

Today it is no denying a fact that trust is enormously powerful in an organisation. People won't do their best unless they will believe that they will be treated fairly-'-that there's no cronyism and everybody has a real shot. The only way we know to create that kind of trust is by laying out our own values and then walking to talk. We have got to do that we say we ‘ll do consistently, over time.

Broadly speaking, trust is defined as reciprocal faith in other's intentions and behaviour. Experts on the subject explain the reciprocal (give and take) aspect of trust in simple terms as ...” when we see others acting in ways that imply that they trust us, we become more dispensed to reciprocate by trusting them more. Conversely, we t come to distrust those whose actions appear to violate our trust or distrust us....” In short we tend to give what we get: trust begets trust, distrust begets distrust.

More specifically, it is being noted here that trust, in general, involves a cognitive leap beyond expectation that reason and experience only would warrant. To take a typical example from police force, suppose a member of the newly formed investigating team of a department works hard based on the assumption that his/her teammates are also working hard. That assumption, on which his/ her trust is based, is a cognitive leap that goes beyond his/her actual experience with the teammates. In fact, when we trust someone we have, no doubt, faith in their good intentions. However, it is also true that the act of trusting someone carries with the inherent risk of betrayal. But todays progressive professionals firmly believe that the benefits of interpersonal trust far outweigh any risks of betrayal trust.

4. Building Trust—A Simple Guideline

The above brief analysis boils down to one single question: How to build Trust? Fortunately, there are six broad guidelines prescribed by the experts in the concerned field. These guidelines should be followed by every professional for building and maintaining trust. These readily available guidelines are:

- develop free, fair and open communication system by keeping informed all team members in plans, programmes and decisions and taking
- feedback regularly.
- Providing support and help to team members being always available and approachable.
- Showing managerial respect to team members by delegating work with decision making authority.
- Practising fairness by giving credits and recognition to deserving team members.
- Trying to be practical by keeping both implied and expressed promises.
- Enhancing credibility by demonstrating good professionalism.

Therefore, in our day to day professional work life, we have to keep in mind always that trust cannot be demanded. It has to be earned.

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Intersection of Digital Advertising and Promotion of Sustainable Development Goals in India: A Study

Niharika Nayak[1]

Santosh Kumar Biswal[2]

Abstract

Digital advertising in India has quickly grown into an effective method not only for selling products, but also for social change. India has approximately 800 million internet users and a thriving digital ecosystem available. Brands, governments and NGOs are increasingly incorporate online platforms to foster social change based effectively on the United Nations' Sustainable Development Goals (SDGs). The present study explores the intersection of digital advertising and promotion of SDGs in India by employing qualitative research approach. Discourse analysis of visuals was used to understand the role of digital advertising in promoting SDGs in India. The study found that digital advertising plays vital role in the domain of health, education, reduction in inequality, protection of children, gender equality, environment, waste management, eradication of poverty and attainment of human rights and social justice.

Keywords: SDGs, Social Media, Qualitative Study, Gender, Development, Social Marketing

1. Introduction

The deviation from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs) embodies significant change in worldwide development aims driven by historical, political and conceptual changes. The MDGs established in 2000 with 21 targets and 60 indicators which primarily aimed to reduce poverty and basic needs in developing nations (Parr, 2016).

[1]Research Scholar, Department of Journalism and Mass Communication, Rama Devi Women's University, Bhubaneswar (India)
[2]Associate Professor, Department of Journalism and Mass Communication, Rama Devi Women's University, Bhubaneswar (India)

After completion of MDGs goals, UN organized the Rio+20 conference in June 2012 to develop a set goals on basis of success and lessons learned from MDGs and it led to the establishment of SDGs. The SDGs were adopted in 2015 presenting an extensive and more life changing agenda. SDGs a comprehensive framework for sustainable development unanimously to all nations have 17 goals and 169 targets in it to tackle the challenges of the 21st century. The SDGs lay emphasis on more combined approach to sustainable development, concentrated on economic development, social inclusion and environment protection to ensure a sustainable future for all (Halisçelik & Soytas, 2019).

The SDGs comprises various core components including goals, indicators, values and practical applications. These 17 goals help to end poverty, protect our planet and assure prosperity by 2030. Indicators have a significant role in measuring the progress in goals with different initiatives established to evaluate sustainability at world, national and local level (Patnaik & Gouda, 2025). Sustainable development is established in standards such as social justice, impartiality and environment admiration leading the formulation of policies and practices. When all the stakeholders such as government, businesses and communities provide synergetic effort to generate solutions, start sustainability technology and stimulate effort to protect the environment and responsibly resource management through which sustainable development can be achieved. This confirms that development meets the requirements of the present without affecting the ability of future generation's needs (Robert et al., 2014).

The SDGs is a purposeful worldwide framework to address universal issues like poverty, inequality and environmental deterioration. Great concern is the variation between environmental sustainability and economic growth, lead to contradictory priorities among nations. Moreover, the SDGs are not non-binding for which countries have created different strategies causing diverse commitment and resource provision. Due to the dearth of reliable data tracking the progress is challenging, particularly in developing countries. Even with these obstacles, a transformative agenda like SDGs can transform by promoting collaboration and innovation (Swain, 2018).

The significant indicators, an important tool for measuring success and finding issues in achieving universal goals trailing the development of sustainable development goals cannot be exaggerated. These indicators make way to obtain the result of various

initiatives, shows that goals are not only aspiring but also useful. The growth of a strong indicator framework is essential for implementing the SDGs, as it facilitates the assessment of main determinants like relevance, credibility and validity (Hák et al., 2016). The application of SDGs needs a complete incorporation across different regions and sectors, showing the interconnectedness of the goals. It is necessary to make sure that development in one part does not challenge another goal (Smith et al., 2017).

According to Samašonok and Išoraitė (2023), the role of communication tools is essential for promoting the SDGs and implementing in various areas. Effective communication tactics not only acquaint people with sustainable development but also inspire them take action for the SDGs. From traditional media like television to advanced media like social media, various communication channels are used to disseminate information and aware people about sustainability. A well designed communication strategy is important for engaging viewers all over the world by increasing their participation in the SDGs and confirming that the goals reproduce on personal level.

Information and Communication Technologies (ICTs) play as an important tool for dynamic development in various sectors. ICT industry provides digital solutions to achieve the SDGs by using different technologies such as mobile broadband and data analysis to improve their services, progress in making information more accessible and maintain inclusive economic development. ICT supports in tracking the progress of the SDGs also used for instant data collection and monitoring. As it became the important part of daily life serving in development and persuade eco-friendly practices in societies and businesses (Jones et al., 2017). Digital advertising, a part of ICTs plays a pivotal role in promoting the SDGs. Indian digital advertising industry developed to over 400 billion Indian rupees' market size in 2023, a substantial increase from 2016 the market size. Due to the advanced progress of the Indian digital media market, it was anticipated that digital advertising expands to over half a trillion Indian rupees within 2024, showing the growing trend that advanced over the past few years (Basuroy, 2024).

It was revealed that a diverse setting of success and challenges for the attainment of SDGs. While there has been remarkable growth in sectors like economy, major gap is

there, particularly in societal and environmental aspect. According to United Nations data, even though given effort and taken action, countries are not on the track to reach the 2030 goals. Among those goals many need quicker action to overcome current discrimination and environmental destruction (Halkos & Gkampoura, 2021). Only 53% of specific targets of country are expected to meet by 2030, with a major area differences, specifically in Africa. It's necessary for a significant change in national and international aid plans to convey determined development issues like use of safe education and sanitation which are major barriers in achieving the sustainability goals. It calls for a re-examine the present strategies to create them more effective and to support vulnerable society (Moyer & Hedden, 2020).

Advertising, one of the strategies, plays a vital role in transformation in raising awareness and taking action for sustainability by promoting sustainable consumption pattern and encouraging social engagement in social and environmental issues (Gouda, 2022). Marketing campaigns inform consumers about the SDGs and it Importance and encourage behavioural transformation, responsible choices as well to support sustainability. Marketing and advertising companies can increase their credibility and brand loyalty by including the SDGs into their CSR strategies. This connection between the marketing objectives and the SDGs is important for utilizing the industries control to advocate for sustainable practices and addressing global challenges (Jones et al., 2017).

In a multiple way digital advertising campaigns can have impact on voters' behaviour, particularly as like the 2020 US presidential election. In spite of investing $8.9 million on a campaign made to influence modest to low information voters and the effect on voters' output was less. Digital advertising can influence voters' choices but that may not be effective for improving voters output, particularly in competitive environments. It is essential to know how digital campaigns impact public engagement and action which is vital for progressing like for sustainability (Aggarwal et al., 2023).

Green advertising has significantly grown in the last 30 years, shows an increasing awareness of environmental problems and require for sustainable marketing practices. Primarily green advertising concentrated on promoting eco-friendly goods through simple claims. However, consumers became unconvinced and aware, advertisers began to use more thoughtful approaches. Researchers identified areas like

sustainability labelling, green consumption culture and effectiveness of green claims. Currently, green advertising is mostly associated with environmental goals, emphasizing on transparency, legitimacy and eco-consciousness in brand messages. Therefore, companies not using green advertising as marketing tool but also as a main part of corporate social responsibility which is influencing both consumer understanding as well as public policy for sustainability (Agarwal & Kumar, 2021).

In Latin America water conservation advertising campaign played a key role in promoting the SDGs particularly Goal 6 "Clean Water and Sanitation", which is focusing to make sure sustainable water and sanitation for all. By using persuasive communication methods that connect with cultural beliefs and social means, targeted adverting plans can engage people. Campaigns which emphasize the society get benefit from water sustainability action can make a message more relevant and help to take action. The advertisements having logical and emotional appeals, with a strong call to action, can increase awareness and participation in water conservation (Sánchez et al., 2024).

For improving healthy consumption health related advertising campaigns plays a important role in promotion, especially for adults and children by enhancing the appeal for vegetables and fruits. These campaigns focused SDGs, particularly 'SDG 2: Zero Hunger' and 'SDG 3: Good health and well-being' dealing with both malnutrition and obesity. These advertisement campaigns can change the food environment to support people to create healthier choices by decreasing the marketing of unhealthy foods which are high in salt, fat and sugar and improve emphasizing the nutritious foods. Moreover, effective adverting can increase awareness on benefits of good diet, so promoting a better health and nutrition. This method develops individual health and maintains extensive public health goals important for sustainable food system (Folkvord et al., 2021).

Some common themes such as "Good Health and wellbeing" and "Gender Equality" found in advertisements focusing on society's major issues. To connect with people and increasing awareness on social issues advertisers use language that is culturally sensitive and relevant images. Customizing messages for dynamic audiences reinforces the effect of these social message fostering positive transformation and growth towards the SDGs in India (Goel & Sharma, 2024).

Corporate Social Responsibility (CSR) supports the SDGs which have a vital role in encouraging the SDGs by giving a context for businesses to support global progress challenges over planned action. Companies address major problems like poverty mitigation, health care, education and eco-friendly practices by integrating their action with the SDGs. It increases the societal impact of their actions as well as encourages innovation and cooperation across areas. By utilizing proficiency, resources and scope to enforce projects directly contribute to the SDGs (KPMG, 2017).

The SDGs execution differs on a global scale and many countries using Voluntary National Reviews (VNRs) to report their improvement and tactics. For example, countries like India have integrated their development agendas with the SDGs giving importance inclusive development along initiatives like "Sabka Sath Sabka Vikas" (Sachdeva, 2022). The VNR method supports the engagement of several stakeholders such as government, private sector and civil society, confirming an extensive approach to sustainable development. Countries can improve their strategies, deploy resources and reinforce international collaboration by sharing top strategies and lessons experienced from these reviews and contributing to the world to achieve the SDGs by 2030.

The culture, advertising and SDGs is essential in creating effective marketing plans which promote sustainable practices. Cultural beliefs majorly influence advertising by giving a context that resonate with customers. Utilizing cultural accounts advertisers can create messages more appealing and boost eco-friendly practices among consumers. The interaction between culture and advertising functions as an influential tool to promote awareness and steps towards reaching SDGs, contributing to complete growth and sustainable development in the society (Soni et al., 2024).

The SDGs through influencing consumer decisions, public opinion and promoting eco-friendly and social cause remain important. Advertising campaigns can positively increase awareness on major problems like poverty, inequality and climate change encouraging individuals to take measures. Brands can increase their credibility and encourage consumers to adopt sustainable habits (Surjani & Dangi, 2024; Chakraborty & Bhat, 2016). Due to technological development and major shift in consumer behaviour, digital advertising has grown significantly. Main trends like increase in video content holds attention of consumer and boost consumer engagement and the

growing social media forums allows collaborative communication between consumers and brands. Personalization supported by big data and artificial intelligence (AI) became a basic strategy to create relevant advertisements and increase brand loyalty. Through this tactics businesses can promote sustainability and raise awareness on social issues (Prihatiningsih et al., 2024).

2. Literature Review

2.1 Social Marketing and Sustainable Development Goals

Social marketing is a paradigm that uses the principles of commercial marketing to change behaviours that benefit individuals and/or communities for the greater social good. It is often used in public health, environmental issues, education and social justice campaigns. Social marketing is the systematic application of marketing activities to reach specific behavioural objectives for social good. Social marketing differs from commercial marketing in that it does not want people to buy a product or service. Rather, social marketing is intended to change people's behaviour or maintain behaviour for the good of the individual and society (Kotler & Zaltman, 1997; Chakraborty, 2019).

Social marketing has been studied in the domain of SDGs (Hübscher, Hensel-Börner & Henseler, 2022), protection of wildlife (Coffie et al., 2025), addressing obesity (Bastos et al., 2022), social marketing efficacy (Polonsky et al., 2025), employee green behaviour (Almansour, 2025) and digital advertising (DeWilde, 2023). However, the present study explores social marketing in the prism of probing digital advertising and promoting the SDGs in India.

2.2 Digital Media and Sustainable Development Goals

Robert et al. (2005) in their study "What is Sustainable Development? Goals, Indicators, Values and Practice" asserted that SDGs is a global background includes 17 interrelated goals intended to deal with global challenges and promote sustainability to a large extent. These goals include several social, economic and environmental

issues like eradication of poverty, gender equality, sustainability initiatives, economic growth and clean water and sanitation.

According to Kates et al. (2005), the SDGs eradicate poverty and inequality and also ensure comprehensive development and environmental sustainability. To measure the progress and accountability, each goal has specific targets and indicators. Researchers added that the SDGs are anticipated to be universally applicable to influencing nation, regardless of their developmental status to implement plans that support these global goals. Also it highlighted the significance of understanding scope and interrelation of the SDGs for encouraging collaboration among governments, private sector and public to achieve SDGs by 2030.

From the MDGs to SDGs took a major shift, representing development in exchange developmental objectives globally. Fukuda Parr (2016) mentioned how the MDGs introduced in 2000, focusing on eradication of poverty and basic needs in developing nations. Because limited scopes and less inclusivity stakeholders expressed concerns that the MDGs were inaccessible in national and global policy discussions and lacking the ability for transformation in institution and economic models. In 2015, the SDGs were introduced to address these problems, shifting towards an inclusive and transformative agenda.

According to Samašonok and Išoraitė (2023), communication tools have a major role in promoting the SDGs. To make complex SDGs concepts accessible to wide range of audience, effective communication approaches are important. Researchers highlighted the significance of different communication channels such as, traditional media, social networks and digital forums in spreading SDGs and sustainable practices related information. The value of targeted groups can effectively influence public behaviour and attitudes towards sustainability. Also mentioned the participatory communication method's value and fosters community involvement and sustainable initiatives responsibilities.

Surjani and Dangi (2024) delved into how advertising as an influential medium to aware and encouraging consumer for sustainable initiatives. Researchers highlighted that efficient advertising strategies inform the SDGs to the people as well as influence behaviour of consumer by developing a responsibility sense and social and

environmental issues resolution. Brands integrate their advertising efforts with specific SDGs by using emotional storytelling and meaningful messaging to enhance their trustworthiness and encouraging sustainable practices among people. The study also emphasized the advertising potential as a tool to advance the global sustainable development strategy.

In the context of Indian advertisements, Soni et al. (2024) studied the connection between advertising, culture and the SDGs. It is necessary to reanalyze marketing strategies to promote sustainable consumption and support cultural values. According to Soni et al., culture is a main pillar of sustainability which influences customer behaviour and advertising content. The study investigated how SDG theme presented and up to what extent they combine traditional cultural practices and revealed that some advertisements incorporate cultural element successfully with eco-friendly messages while other show detach between traditional value and modern advertising. Researchers emphasized the significance of culturally relevant advertising in promoting sustainable consumption and integration of local cultural narratives to improve the effectiveness of sustainability communication.

Agarwal and Kumar (2021) conducted a systematic literature review on green advertising, underscoring its evolution and significance in the context of consumer awareness and environmental concerns. The study emphasized the significance of effective green advertising strategy in persuading consumer behaviour and integrated marketing practices with sustainable goals. Sánchez et al. (2024) studied the water conservation advertising campaigns in Latin America to examine communication frames and categorized these persuasive strategies based campaigns to promote eco-friendly behaviour. The study found the common persuasive strategy in campaigns is the loss approach, emphasized the negative results of water waste. The advertisements primarily feature indirect messages and unclear recipient which limit their effectiveness. Also, study identified a mixed appeal, emotional and logical appeals which can enhance engagement and influence behavioural change.

Abril and Dempsey (2019) reviewed literature systematically to find the effectiveness of healthy eating advertisements focusing on results related to stop (unhealthy eating behaviour), go (healthy eating behaviour) or both. The study assessed healthy eating advertisement interventions since unhealthy eating is a major contributor health

problem like obesity, heart disease, stroke and Type 2 diabetes. The study findings indicate that both stop and go or offering other ways to engage in healthy eating by focusing on waist size, may lead to better result. Also, it found that campaigns longer than six months appeared more consistently successful.

Deng Ting and Ibrahim (2024) studied "Research on the Interactive Effects of Parenting Advertising under the Sustainable Development Goals (SDGs)" to evaluate the impact of effective advertising interactive methods to train abusive parents for effective parenting through advertising. The study revealed the multi-sensory advertising interaction model including visual, auditory and multisensory influencing different levels of attention, memory and emotions in the context of parenting advertisement. This model meant to lead the effective presentation of parenting public service advertisements, eventually promoting healthier family atmosphere which is supporting 'SDG 3: Good Health and Well-being'.

Goel and Sharma (2024) focused on language presentation of social, governance and environmental concerns (ESG) in social advertisements. By analyzing linguistic features and details of different advertisements study identified the main societal issues that need attention for call to action. The importance of themes such as "Good Health and Well-being" and "Gender Equality" emphasizes a strong focus on these areas. Moreover, the different linguistic differences between Hindi and English advertisements; English language mostly use scientific terms and formal vocabulary whereas Hindi advertisements use relatable experience to connect with audience. This strategy emphasizes the importance of considering culture and language while crafting social messages.

2.3 Advertising and SDGs

Sujani and Dangi (2024) conducted a research on role of advertising in promoting the SDGs to analyze its effectiveness to aware public, persuading consumer behaviour and the impact of sustainable advertising in improving brand image. The study found that sustainable advertising has a pivotal role in progressing SDGs among youth in India. Effective advertising strategies raise awareness and lead to change in consumer

behaviour and approaches. Brands aligned with the SDGs enhanced reliability, trustworthiness and support, eventually contributing to a sustainable future. Also highlighted that advertising is an influential tool for manage societal and environmental change emphasizing the significance of strategic advertising.

Aggarwal et al. (2023) delved in to how targeted advertisements shaped voting behaviour among votes in five battleground states, focusing on impact of digital advertising campaign during the 2020 US presidential election. Advertisements conveyed through social media to influence people to vote against Joe Biden and Donald Trump. Researchers found that the program had an overall impact on voters' turnout, didn't make much difference in turnout. It emphasized the modest impact of advertising campaign on voters' turnout.

Prihatiningsih et al. (2025) studied on digital advertising trends and the impacts of advertisements and social media in user engagement, conversion rate, brand awareness among views and consumer loyalty. The study revealed that video content is very effective in grabbing attention and upholding consumer interest for a long time than text or static images. Social media make possible interactive communication between brands and consumers which fosters strong relationships with consumers. Incorporating video content with social media platforms like YouTube, Facebook, Instagram and TikTok raises engagement and change. Also, personalization of advertisements using AI technologies leads to higher engagement. However, the extant literature has focused on the role of media and communication in the light of the SDGs. However, scanty scientific studies have paid attention to the intersection of digital advertising and promotion of the SDGs in India.

Based on the discussion the following two research objectives are formulated:

- To analyze various digital advertising campaigns aligning with the SDGs
- To examine the role of digital advertising in promoting SDGs from timeline perspectives

3. Research Methodology

The study engaged with the investigation of digital advertising campaigns drawn from the digital media platforms. To ensure significance and alignment of advertising with SDGs, the present study selected advertising of time period from 2015 to the February 2025. The selected advertising has immense impact on the audience and potential presence in various digital platforms. Each digital advertisement categorized according to organization covered and the advertisements aligned with which of the SDGs. A qualitative visual analysis tool was used to explore images, videos, advertisements, posters, movies and other visuals to examine the meaning, symbolism, representation and cultural context. Whereas quantitative visual analysis tools focus on counting frequencies, qualitative visual analysis tools prioritize interpretation and depth (Ceuterick & Malet, 2024). The present study used discourse analysis of visuals (Matta, 2024) to look into the intersection of digital advertising and promoting the SDGs in India.

4. Findings, Analysis & Discussion

When MDGs were changed into SDGs in 2015, India presented as a great example of the make sure growth is sustainable. Government, corporate and NGOs launched digital advertising campaigns in India to promote sustainability. While some campaign addressed completely aligned with the SDGs such as poverty mitigation, well-being, environmental sustainability, others may not align but linked to different SDGs agendas. It highlighted the significance of advertising in raising awareness, persuading behaviour and urging positive shift in wide range of societal and environmental issues. It is important in enduring sustainability even if it is not linked directly to the SDGs.

Indian companies have targeted youngsters to promote green practices and sell products with societal and environmental campaigns in three main categories. In first category, it involves children to stimulate positive behaviour in adults. A campaign by Surf Excel keeps India clean, children influencing the adults not to mess. This detergent brand through digital advertising promotes ‘SDG Goal 6: Clean Water and Sanitation’ which remains important for human lives across the globe. Unilever’s Lifebuoy campaigns on ‘Help a child reach 5’campaign, promoting hand wash to avoid

diarrhea. This brand promotes children's behaviour change which is aligned with 'SDG 3: Good Health and Well-being' and 'SDG Goal 6: Clean Water and Sanitation'.

National Scholarship portal, a digital platform, helps Indian students to find and apply various scholarship provided by both state and central government. Advertising campaign for National Scholarship Portal which supports 'SDG 1: Eradication of Poverty', 'SDG 4: Quality Education', 'SDG 5: Gender Equality' and 'SDG 10: Reduction in Inequality'. It provides access to scholarships and promotes opportunities for education to students of different backgrounds like marginalized or underprivileged people, helps in eliminating financial obstacles to higher education, supports to reduce inequality, contribute to discontinuity the cycle of poverty.

The 'Beti Bachao Beti Padhao' advertising campaign from the Government of India aims to reduce gender bias and make sure that girls have the same opportunities as boys and focuses on increase the well-being, safety and healthiness of girls. It supports 'Selfie with Daughter' campaign, endorsed by social activist Sunil Jaglan persuades parents to take selfies with their daughters and share in the social media platforms. This campaign uses Facebook and WhatsApp to reach out to the people. Such digital endorsement 'Selfie with Daughter' is aligned with the SDGs 5 Gender Equality, SDGs 10 Reduction in Inequality. Educate girl and empower nation campaign aimed to encourage society to embrace daughters and promote to educate girls which will contribute in nation's development. Platforms like YouTube promote this thought which is aligned with 'SDG4; Quality Education', 'SDG5: Gender Equality' and 'SDG 10: Reduction in Inequality' are placed in digital display boards to aware people on the mentioned areas.

Through 'Swachh Bharat Mission', the Government of India tries to make India sustainable. Under this campaign, 'Clean India Green India', the Government of India attempts to improve managing waste and sanitation which have impacts directly on water quality and public health. To make it more regiour, the campaign in the form of both traditional and digital mediums like YouTube, Facebook and other social media intends to attain sustainable development by endorsing cleanliness, hygiene and environmental sustainability.

A cleaner and greener India has targeted on sustainability by reducing recycle waste and responsible use of resources. It directly aligns with 'SDG 6: Clean Water and Sanitation', 'SDG 11: Sustainable Cities and Communities', 'SDG 12: Responsible Consumption and Production', 'SDG 13: Climate Action and 'SDG 15: Life on Land', which focuses on sanitation facilities, clean water for all, decreasing waste particularly use of plastic. 'Swachh Bharat Swasth Bharat' campaign placed in YouTube and Facebook, has a key role to reach these SDGs not only by focusing on the physical features of cleanliness also prompting change in behaviour related to sanitation, hygiene and waste management. This campaign focuses on 'SDG 3: Good Health and Well-being', 'SDG 6: Clean Water and Sanitation', 'SDG 11: Sustainable Cities and Communities', 'SDGs 12: Responsible Consumption and Production' and 'SDG 13: Climate Action'.

The 'Pradhan Mantri Ujjala Yojana (PMUY)' aims to provide free LPG for BPL households which support the SDGs. The advertisement campaign 'Ujjwala se Ujjwal Bharat' attempts to bring awareness among the people for this scheme, reducing financial problems. The scheme discourages to buy the traditional cooking fuel and improves marginalized people's living standard. Advertisements placed in several social media in the form of videos and image carousel by showing emotional storytelling by targeting rural and semi urban areas and Google display advertisements to aware about benefits of schemes. This campaign directly aligns with 'SDG 1: No Poverty', 'SDG 3: Good Health and Well-being', 'SDG 7: Affordable and Clean Energy' and 'SDG 13: Climate Action'.

The UNICEF represents the growth over 75 years in developing children lives across India by offering access to education, health and malnutrition, child labour. Its advertisement campaigns 'Har Bacha Hai Khaas: Unka Haq Hai Shiksha aur Swasthya', through digital forms focus on childrens' education and health which is aligned with 'SDG 1: Eradication of Poverty', 'SDG 3: Good Health and Well-Being', 'SDG 4: Quality Education', 'SDG 5: Gender Equality', 'SDG10: Reduced Inequality' placed in various social media like Facebook, YouTube. Campaign UNICEF: Har Bachhe Ka Haq, a motivational message forwarded through WhatsApp to donate. This campaign aligned with 'SDG 1: Eradication of Poverty', 'SDG 3: Good Health and Well-Being', 'SDG 4: Quality Education', 'SDG 5: Gender Equality', 'SDG10:

Reduced Inequality' and 'SDG 17: Partnerships for the goals, indicating UNICEF's responsibility to improving lives of children and presenting global concerns.

The non-profit organization Akshaya Patra Foundation's digital advertisement having message 'one meal can change a child's life' promote government mid-day meal initiative which focused on 'SDG 2: ending hunger and malnutrition', 'SDG 4: quality education', 'SDG 10: Reduced inequalities'. Similarly, New Year New Resolutions, 'Full plates for all' encourages donations which may help to provide meals to 2.25 million of children promoted by video advertisements in YouTube. It focuses on 'SDG 2: ending hunger and malnutrition', 'SDG 3: Good Health and Well-being', 'SDG 4: Quality Education', 'SDG 10: Reduction in Inequality' and 'SDG 17: Partnerships for the Goals. It started at the New Year by committing to provide full plate meal to unprivileged children which may increase children's' attendance and decreases dropout percentage leading to social development.

The Child Rights and You (CRY), an NGO working for childrens' happier and healthier childhood and have concern on child labour, exploitation, malnutrition, lack of education, health care and poverty. 'Change this Story' campaign on malnutrition presented in the platforms like Facebook and YouTube in the form of video advertisements and carousel advertisement highlights the challenges faced by children in India and encourages donations to support CRY. The advertisement focused on children's' education, health and their protection and directly aligns with 'SDG 2: ending hunger and malnutrition', 'SDG 3: Good Health and Well-being', 'SDG 4: Quality Education' and 'SDG 10: Reduction in Inequality'. Similarly, 'Help children stay in school', an image advertisement on YouTube promoting child education by encouraging donations. It supports 'SDG 1: Eradication of Poverty', 'SDG 4: Quality Education', 'SDG 5: Gender Equality' and 'SDG 10: Reduction in Inequality' to increase donation for children's quality education in India.

Bal Raksha Bharat focuses on children's' rights, education, health and nutrition and concern about child labour, child abuse and exploitation and also for disaster management. The campaign 'Secure the childhood secure the future' in digital forms is associated with 'SDG 1: eradication of poverty', 'SDG 2: End hunger', 'SDG 3: Good Health and Well-being', 'SDG 4: Quality Education', 'SDG 5: Gender Equality' and 'SDG10: Reduced Inequalities'. The digital advertisement campaign, 'Be a hero

to a child' from Bal Raksha Bharat motivates to donate 500 rupees to save a child, their care and to protect children which is directly associated with 'SDG 3: Good Health and Well-being', 'SDG 4: Quality Education' and 'SDG 16: Peace, Justice and Strong Institutions'. Similarly, this same organization in forms of digital platforms promotes 'For every last child' advocates for the inclusion of unprivileged children in the developmental program aligned with 'SDG 2: Zero hunger', 'SDG 3: Good Health and Well-being' and 'SDG 4: Quality Education'.

Oxfam India, a prominent NGO is working on social justice, human rights, economic inequality and climate change. Its digital campaign 'India without discrimination' functions to end discrimination and create discrimination free society through various social media platforms like Facebook and Instagram. It aims to raise awareness about economic and social inequalities and encouraging collaborative action for societal transformation. This campaign directly aligns with 'SDG 1: No Poverty', 'SDG 5: Gender Equality', 'SDG 8: Decent Work and Economic Growth' and 'SDG 10: Reduced Inequalities'. Another advertisement 'Together we make change happen' in social media raise awareness on major issues like poverty, gender discrimination, injustice aligned with 'SDG 1: No poverty', 'SDG 5: Gender equality', 'SDG 10: Reduced inequalities' and 'SDG 16: Peace, justice and strong institutions'. It featured primarily on YouTube including a series of short videos and banners which is designed to encourage viewers for donation and their participation.

Amul, a leading dairy company's advertisement 'The Taste of India' showcases on social media platforms such as Instagram and Facebook highlighted essential role of Amul product which provides nourishment, contribution to Indian food system and promotes healthy food as a solution to malnutrition. It focuses on 'SDG 2: Eradication of hunger', 'SDG 3: Good Health and Well-being', 'SDG 12: Responsible Consumption and Production' and 'SDG 13: Climate Action'. 'Amul Kool -Chill Your Dil' on YouTube and Instagram, emphasizing on the significance of clean, quality ingredients in beverages. It focuses on the SDG 6, use of water in making procedure and water management practices which directly contributing to water sustainability effort worldwide. It also directly aligns with 'Goal 3: Ensure healthy lives and promote well-being for all at all ages'.

Ariel, a leading detergent company, promotes gender equality through digital advertising campaign ‘Share the Load’ which counters the traditional gender roles featured in all social media. With video advertisements and influencers collaborations, it uses real life scenario, highlighting the gender equality in daily life. It is directly associated with ‘SDG 5: Gender Equality’. This campaign effectively encourages an exchange of gender roles and responsibilities in the home and helps to change social belief towards gender equality.

The campaign ‘You Can’t Stop Us’ is aligned with the cultural moment. The advertisement showcases Nike’s creativity as well as expressed the message of unity and shared human experience. By presenting athletes from diverse backgrounds, Nike shows its commitment for the sense of inclusion and equality. This advertisement campaign aligns with ‘SDG 9: Industry, Innovation’, ‘SDG 10: Reduction in Inequality and Infrastructure’ and ‘SDG 12: Responsible Consumption and Production’. Similarly, the campaign ‘Move to Zero’ focuses on reusing existing plastics, yarns and textiles and designing entirely new materials, moving towards zero carbon and zero waste. By reducing carbon emission and influence ecofriendly product consumption ethically it supports ‘SDG 12: Responsible Consumption and Production’ and ‘SDG 13: Climate Action’. For both of the advertisement campaigns, Nike employs various social media platforms and also showed strong presence through mobile app and email marketing.

Well known mobile network Vodafone’s digital campaign ‘LiveMore’ emphasizes peoples’ wish to step out and explore their passion, the opportunities that technology brings to make everybody’s lives more pleasant. It aligns with ‘SDG 9: Industry, Innovation and Infrastructure’ which encourages people to live more with Vodafone Super Net 4G, use mobile technology and data to fulfill their dreams. Similarly, Vodafone’s campaign 'Be Someone's We' showcases cheering moments, evoking a strong emotional response by using Vi's reliable connection. This advertisement affects viewers on an emotional level, uncovering absolute feelings that often go unexpressed. All these campaigns by Vodafone network presented through video advertisements on different social media platforms showing digital connectivity and innovation. And it also highlights the role of technology in motivating innovation as well as economic growth which are aligned with SDG 8 and SDG 9.

The campaign ‘Tata Tea Jaago re’ from Tata Tea attempts to bring awareness on climate change and influences the parents to ensure a sustainable environment for future generation to live. To make message clear and memorable, this consumer brand uses nursery rhymes with a new communication to appeal to fight climate change, showing how our favorite poems may change for our children if we don’t take action against climate change. It directly aligns with ‘SDG 3: Good Health and Well-being’, ‘SDG 6: Clean Water and Sanitation’, ‘SDG 12: Responsible Consumption and Production’ and ‘SDG 13: Climate Action’. This brand runs several advertisements about various social problems such as women empowerment, education, environment and positive social change which is featured in form of video advertisements on social media platforms and encourages people to take action on major issues affecting our society.

5. Conclusion

This research explores various digital advertising in India, focusing on promotion of the SDGs. The advertisements are to “peace and prosperity for people and the planet”. These digital advertisements showcase the link between environmental, social and economic dimensions of sustainable development. Sustainability remains the core of SDGs which is drawing attention worldwide (United Nations, 2023).

The current study finds novel in the realm of the role of digital advertisements in promoting the SDGs in India. As digital advertisements are getting intensified, consumer engagement with the SDGs is increasingly felt. Consumers are becoming part of developmental discourse. There has been two-way communication between the consumers and various developmental agencies like government, NGOS and corporates. Moreover, consumers or citizens are increasingly empowered to realise the SDGs in their daily lives. The study finds that in India there are several digital advertisements which focused on more than one SDG. It asserts that a single digital advertisement can cater to realise more than one SDG. In India, gender issues remain grave and warrant comprehensive approach to mitigate the issue. The current study explores that there are certain digital advertisements which specifically focus on gender equality. It empowers this disadvantage community and attempts to make them to be part of developmental discourse in India.

India lives in villages. There is no dearth of rural issues which need immediate attention. In this context, the current study unravels that certain digital advertisements highlight rural issues which are aligned with 'SDG 1: No poverty' and 'SDG 2: Zero hunger'. These digital advertisements argue for the importance of rural development in India. Since rural development is a complex phenomenon in India, such digital advertisements have made sincere efforts to comprehend the rural issues and rural development. It emphasizes the critical role of advertisements in shaping social perceptions and reaching SDGs.

As India in growing stage and contributing to the SDGs, the role of digital advertisements will be crucial in addressing social and environmental issues in positive change. The current study explores that digital advertisements on SDGs are coming along print advertisements. Earlier, such advertisements were coming in print forms only. These days to make the campaign holistic and effective, digital advertisements are there along with advertisements in newspapers, magazines and TV channels to bring awareness on the SDGs.

6. Theoretical Contributions

This study adds to the growth of social marketing theory by extending its domain to digital advertising as a strategic vehicle for promoting the SDGs. Traditional social marketing has focused heavily on health, safety and public welfare campaigns and has been viewed through the lens of traditional media; this study takes that lens towards the digital space where social influence, personalization and nudging have the capacity to extend significantly.

While social marketing theory has been used to address more discrete behavioural issues including smoking cessation, disease prevention in the past, this study positions the SDGs as a holistic practice for behaviour change that would require multi-dimensional and sustained behaviour change. By integrating and aligning with the 17 SDGs with the principles of social marketing, the study demonstrates that digital advertising can address social, environmental and economic behaviours at equivalent scales particularly in the case of climate action (SDG 13), gender equality (SDG 5) and responsible consumption and production (SDG 12).

Traditionally, social marketing theory concentrates on behaviour change at the individual level. This research has added a systems-oriented lens, demonstrating collective action and cultural change can be instigated by digital advertising fuelled campaigns which foster movements, mobilise communities and have an impact on policy like global climate strikes or a viral sustainability challenge. The new lens of social marketing conceptualises social marketing as much more than a tool for individual change but rather as a mechanism for changing society, ultimately contributing to the overarching goal of the SDGs.

7. Future Research Agenda

In the era where environmental and societal concerns became important, these findings offer keen understanding for advertisers, policymakers and researchers. Since the current study is qualitative in nature, a mixed methods study and quantitative study can be conducted in the future. Since the present study adopted discourse analysis of visuals, future studies can be initiated to understand the impact of digital advertising in promoting the SDGs in India through conversational analysis (CA), critical discourse analysis (CDA) and narrative analysis.

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Predicting Stock Prices Using Neural Network in Energy Sector

Satarupa Misra[1]

Shreyas P[2]

Abstract

Stock price prediction is a complex and challenging task that plays a crucial role in the financial domain. In this study, we investigate the use of a neural network model to predict stock prices of selected companies based on various economic covariates. The dataset is divided into training and testing sets. We explore the impact of each covariate on the dependent variables and assess the model's performance. The testing phase demonstrates the model's capacity to predict stock prices with reasonable accuracy. Furthermore, we conduct in-depth evaluations of specific dependent variables and analyze the standard deviations of actual and predicted stock prices. Our findings indicate that the neural network predictions are generally reliable, although certain stocks exhibit higher volatility in their actual prices.

Key Words: Neural Network, Data Mining, Economic Indicators

1. Introduction

In highly volatile market predicting stock price is a complex phenomenon. In this dynamic market developing a causal relationship is tedious task. In stock price prediction, various factors need to be identified that may influence stock prices. Under traditional method market prediction is by intuition and statistical methods. In current research, neural network (NN) is used to understand the pattern and predict the future trend. Neural networks can capture complex non-linear relationships in the data, which is often challenging for traditional models based on linear regression or autoregressive techniques. Financial markets are known for their non-linear and dynamic nature, and neural networks are well-suited to learn and represent these intricate patterns. Neural network has the ability to predict the financial time series movement (Persio & Honchar, 2016).

[1] Assistant Professor, MBA Department, Presidency College, Bangalore
[2] EFA Analyst, Deloitte Inc Bangalore

Artificial neural network is becoming a predominant tool for predicting stock price. In case of large data base, neural network models are the appropriate method for forecasting (Fund & Filtman, 2001). Financial data can be noisy and subject to outliers. Neural networks are generally robust to noisy data, and their ability to learn from large datasets helps mitigate the impact of outliers on predictions. Accurate predictions can enhance investment decisions, helping investors identify potential profitable opportunities and manage risk effectively. By leveraging neural networks' capacity to capture non-linear dependencies and analyze high-dimensional data, financial professionals can gain a deeper understanding of market dynamics and make more informed choices.

This study contributes to the understanding of utilizing neural networks for stock price prediction, highlighting the significance of economic covariates and their impact on the model's accuracy. Our findings indicate that the neural network predictions are generally reliable, although certain stocks exhibit higher volatility in their actual prices. The paper is structured as follows. Section 2 reveals the literature. Section 3 will be methodology followed with result and discussion in section 4. Section 5 concludes the paper.

2. Literature Review

Various literatures are available on prediction related to financial time series analysis. Though neural network is widely use in current research but there were research conducted during 1990s.

Kimoto et al (1990) proposed modular proposed a modular neural network system for stock market prediction. They demonstrated the effectiveness of neural networks in predicting stock prices and the benefits of modularizing the network architecture. Zhang et al. (1998) conducted a comprehensive review of the recent technology used in forecasting with artificial neural networks. They highlighted the advantages of neural networks in capturing complex relationships in financial time series data and their potential for stock price prediction. Tsantekidis et al. (2017) proposed using convolutional neural networks to predict stock prices based on the limit order book. Their study showcased the versatility of neural networks for different types of financial data. Fischer and Krauss (2018) examined the use of deep learning with

LSTM networks for stock market predictions, considering a group of stock prices. Their study demonstrated the superiority of LSTM networks over traditional models in predicting financial time series. Lima and Sousa (2019) explored the application of LSTM neural networks for predicting stock market prices, with a focus on their potential for long-term forecasting. The study offered insights into the use of LSTM for predicting stock prices in various market conditions, including the energy sector. Zhang et al (2020) incorporated attention mechanisms to enhance the neural network's focus on essential features and improve prediction accuracy for energy stock prices. Zhao and Dong (2021) exemplifies the ongoing efforts to develop sophisticated models that leverage multiple neural network architectures for forecasting energy sector stock prices. Several studies reported promising results using LSTM networks for stock price prediction, achieving more correctness compared to conventional methods (Schaefer et al., 2016; Jiang et al., 2017). Research expanded to incorporating diverse data sources beyond historical prices, such as news sentiment, social media analysis, and economic indicators (Zhang et al., 2018; Wu et al., 2019). For instance, Shi et al. (2022) introduced a hybrid model that integrates CNN-LSTM and attention mechanisms and presented enhanced forecasting accuracy. Pant and Kaur (2020) developed an intelligent model combining LSTM and GRU neural networks for stock price prediction. Their hybrid approach demonstrated enhanced accuracy and faster convergence compared to individual models, effectively capturing complex temporal patterns in financial data.

Along the same lines, Liu (2018) applied attention-based Bi-LSTM models to financial news, emphasizing the utility of text data in directional prediction. While results were promising, some studies reported difficulties concerning model interpretability, over fitting, and applicability to actual trading. These limitations highlight the importance of interpretable neural structures and extensive testing under various market settings.

Pang et al. (2020) have suggested a hybrid model of convolutional neural networks (CNN) and long short-term memory (LSTM) networks for forecasting the stock market. Their model efficiently extracts both spatial and temporal features of financial time series, performing better than conventional models such as isolated LSTM and MLP. The research indicates enhanced accuracy and resilience over

benchmark datasets, utilizing evaluation metrics like MAE and RMSE. Interestingly, the use of attention mechanisms improves the interpretability of the model. This pioneering method illustrates the capabilities of deep learning in stock market forecasting and managing the complexity and nonlinearity involved in stock market data.

While neural networks have exhibited significant potential in predicting stock prices, there is little attention devoted to the special features of the energy industry, especially with regards to utilizing understandable, real-time, and industry-specific neural networks. In addition, issues relating to model explain ability, integration of various factors (macro-economic factors) that influence while predicting stock price.

3. Methodology

The study considers a dataset comprising the closing prices of the energy sector companies over a period of 10 years. This dataset enables the analysis of how the closing prices of energy sector stocks have changed over the specified decade. The energy sector is characterized by its complex and dynamic nature, influenced by a multitude of factors such as economic conditions, geopolitical events, commodity prices, and technological advancements. Predicting stock prices for energy sector companies accurately remains a challenging task due to the inherent uncertainties and interdependencies in the market. Traditional forecasting methods may not effectively capture the non-linear relationships and time-series dynamics present in the energy sector data. The objective of this study is to develop a robust predictive model using neural networks to forecast stock prices in the energy sector. By leveraging the capabilities of neural networks to capture intricate patterns and non-linear dependencies in financial time series data, the study seeks to improve the accuracy and reliability of stock price predictions for energy companies. Additionally, the model will incorporate relevant macroeconomic indicators, such as GDP, repo rate, inflation, and the energy index, to account for broader economic trends that influence the performance of the energy sector. GDP (Gross Domestic Product) reflects overall economic growth; increasing GDP tends to improve investor confidence and stock market performance.

Repo Rate is the interest rate at which central banks provide loans to commercial banks; when the repo rate comes down, the market tends to be stimulated, whereas a rise in repo rate can slow the market. Inflation Rate reflects the pace of price increase; excessive inflation can reduce corporate earnings and investors' returns, impacting stock valuations negatively. Energy Index represents the performance of stocks in the energy sector; movements can impact overall market direction, particularly in energy-based economies or businesses. Macro-economic factors have taken as covariates (Pahlawan et.al 2021) to understand stock price prediction. Furthermore, this study recognizes the significance of handling the time-series nature of energy sector stock price data, as past price movements often influence future trends.

For Stock price prediction artificial neural network model is used. Neural networks, particularly LSTM and other recurrent models, are employed to effectively capture these temporal dependencies and patterns, allowing for more accurate and reliable predictions over different time horizons.

4. Data Analysis

The neural network architecture consists of an input layer with four covariates (GDP, repo rate, inflation rate, ENERGY index). It has a hidden layer with nine units, utilizing the hyperbolic tangent activation function. The output layer comprises of nine dependent variables related to stock prices. The activation function for the output layer is the identity function, and the error function used is the sum of squares. Both the covariates and dependent variables are standardized in terms of rescaling. The bias unit is excluded from the hidden layer. (table 1)

The diagram of a neural network has two hidden layers (Figure 1). The first hidden layer has 13 neurons, and the second hidden layer has 10 neurons. The output layer has a single neuron, which represents the predicted value.

Table 1: Network information

Input Layer	Covariates	1	GDP
		2	repo rate
		3	inflation rate
		4	ENERGY index
	Number of Units[a]		4
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		9
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	NHPC Close Price
		2	NTPC Close Price
		3	power grid Close Price
		4	reliance Close Price
		5	tata Close Price
		6	cess Close Price
		7	jaipraksh Close Price
		8	Gujrat industrial Close Price
		9	bf utilities Close Price
	Number of Units		9
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares

Figure 1: Hidden layer activation function: Hyperbolic tangent

The two activation functions used in the neural network are the hyperbolic tangent function and the identity function. The hyperbolic tangent function is a non-linear function that is often used in neural networks because it can read complicated relationships between input and output values. The identity function is a linear function that simply passes the input value to the output layer.

The relationship between the input and output values of the neural network is determined by the weights and biases of the network. The weights are the connections between the neurons in the network, and the biases are the values that are added to the output of each neuron. The weights and biases are adjusted during the training process, so that the network learns to predict the output value as accurately as possible.

The thickness of the lines shows there is a higher level of impact of a variable effecting the stock prices. The covariate GDP as a thicker line effecting H (1:3) Hidden layer which as a thicker line connecting to reliance stock (output).GDP is impacting even the hidden layer H (1:1) Hidden layer with a thicker line which is impacting the NHPC stocks.

Repo rate input as thicker line connecting H (1:3) which is impacting reliance stocks, BF utilities and Gujrat industrial stocks. Inflation rate as a two thick lines connecting Hidden Layer H (1:4) and H (1:7) which is impacting the stocks BF utilities through hidden layer H (1:4) and NTPC and NHPC stocks through the hidden layer H (1:7).

The energy index as thicker line connecting hidden layer H (1:1), and less thick line connecting H (1:7), which are impacting stocker NHPC and NTPC through H (1:7) and stocks TATA and Reliance is impacted through the Hidden Layer H (1:1) the input basis are impacted the hidden layer H (1:4) which is impacting the stocks BF Utilities and the hidden layer basis are impacting the stocks connecting to them. Overall, outputs which are having thicker line have higher level of impact.

The sum of squares error for the training phase was 1024.453, and the average overall relative error was 0.129 (Table 2). This indicates that the model's predictions were reasonably close to the actual values of the dependent variables. The stopping rule used was 1 consecutive step(s) with no decrease in error. The training time was 0:00:00.94 seconds.

Table 2: Model Summary

Training	Sum of Squares Error		1024.453
	Average Overall Relative Error		.129
	Relative Error for Scale Dependents	NHPC Close Price	.140
		NTPC Close Price	.141
		power grid Close Price	.070
		reliance Close Price	.060
		TATA Close Price	.070
		CESE Close Price	.109
		Jaipraksh Close Price	.166
		Gujrat industrial Close Price	.227
		bf utilities Close Price	.180
	Stopping Rule Used		1 consecutive step(s) with no decrease in error[a]
	Training Time		0:00:00.94
Testing	Sum of Squares Error		476.188
	Average Overall Relative Error		.134
	Relative Error for Scale Dependents	NHPC Close Price	.139
		NTPC Close Price	.132
		Power grid Close Price	.081
		Reliance Close Price	.057
		Tata Close Price	.071
		Cesc Close Price	.116
		Jaipraksh Close Price	.207
		Gujrat industrial Close Price	.216
		BF utilities Close Price	.193

The model was then tested on a separate dataset of 5 years of stock market data for the same 9 companies. The sum of squares error for the testing phase was 476.188, and the average overall relative error was 0.134. This indicates that the model's predictions were still reasonably close to the actual values of the dependent variables, but the accuracy was slightly lower than the training phase.

The neural network output can be interpreted as a way of understanding how the neural network is making its predictions. The higher the probability for a particular digit, the more confident the neural network is that the image represents that digit.

It is important to note that the neural network output table is only a representation of how the neural network is making its predictions. The actual predictions made by the neural network may be different, depending on the specific image that is being classified.

Table 3: Independent Variable Importance

	Importance	Normalized Importance
GDP	.270	100.0%
repo rate	.240	88.7%
inflation rate	.229	84.8%
ENERGY index	.261	96.7%

Table 3 summaries macroeconomic factors and their normalized importance. GDP has an importance value of 0.270, which is the highest among the independent variables. It indicates that GDP has the most significant impact on predicting the dependent variables. Similarly, Repo rate has an importance value of 0.240, which is the second-highest. It suggests that repo rate also plays a substantial role in predicting the dependent variables. Inflation rate has an importance value of 0.229, which is slightly lower than repo rate but still significant. ENERGY index has an importance value of 0.261, which is higher than repo rate and inflation rate but slightly lower than GDP.

Overall, based on the normalized importance values, GDP appears to be the most influential independent variable in predicting the dependent variables. However, it's important to note that the importance values represent the relative importance within the given set of independent variables and may not reflect the absolute importance in a broader context.

This analysis suggests that GDP, repo rate, inflation rate, and ENERGY index all have a notable impact on the dependent variables. Considering their respective importance values can help in understanding and interpreting the relationships between these independent variables and the dependent variables in the context of the given model.

The research implication of this study can be summarized by taking into account three dimensions. Firstly, it provides avenues to compare different neural architectures (LSTM, CNN) for time-series forecasting in energy stock performance. Secondly, Promotes investigation of hybrid AI models integrating neural networks with econometric or tentative logic models for better accuracy. Lastly, this research facilitates interdisciplinary research connecting stock price behavior with energy production, sustainability initiatives, and geopolitical considerations.

5. Scope for further research

This paper has considered only energy sector stock and price forecasting technique using macro-economic factors such as GDP, Inflation, reporate and Energy index. This research gives window to various other factors that can influence stock price prediction. There is also scope for analyzing a comparative model by using traditional method and ANN-LSTM as predictive model.

6. Conclusion

This study presented a comprehensive analysis of a neural network model designed to predict stock prices based on macroeconomic covariates. The dataset was carefully divided into training and testing sets, with the neural network architecture consisting of an input layer with four covariates (GDP, repo rate, inflation rate, ENERGY index), a hidden layer with nine units using the hyperbolic tangent activation function, and an output layer with nine dependent variables representing stock prices.

The model demonstrated promising performance during both the training and testing phases, with reasonably close predictions to the actual stock prices. The analysis revealed that GDP played a crucial role in predicting the dependent variables, followed closely by the ENERGY index, repo rate, and inflation rate. These findings highlight the importance of economic indicators in understanding and forecasting stock market trends.

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Sustainable Sustenance: Reimagining Bundelkhand's Cuisine for Cultural Preservation and Environmental Resilience

Dr. Shivansu Sachan[1]

Dr. Mridulesh Singh[2]

Abstract

Bundelkhand, a semi-arid region in central India, faces significant challenges such as water scarcity, drought, and economic distress, which threaten its cultural and environmental sustainability. This chapter explores how the region's traditional cuisine, rooted in climate-resilient crops like millets and non-timber forest products (NTFPs) such as mahua and chironji, can serve as a cornerstone for sustainable development. By reviving traditional dishes, promoting sustainable agricultural practices, and leveraging food processing and culinary tourism, Bundelkhand's cuisine offers pathways to enhance food security, preserve cultural heritage, and empower local communities, particularly women. The study addresses challenges like modernization, climate change, and infrastructure limitations, proposing strategies such as documentation of recipes, adoption of improved cookstoves, and market linkages for value-added products. Through these efforts, Bundelkhand's culinary heritage can foster environmental resilience, economic growth, and social equity, aligning with the principles of sustainable development.

Keywords: Bundelkhand Cuisine, Sustainable Development, Food Security, Culinary Tourism, Women Empowerment, Sustainable Agriculture

1. Introduction

Bundelkhand, a region spanning parts of Uttar Pradesh and Madhya Pradesh in central India, is a land of rich cultural heritage and stark environmental challenges. Known for its historical forts, vibrant folk traditions, and resilient communities, Bundelkhand

[1]Director (Hospitality), Assistant Professor, School of Hotel Management, Chhatrapati Shahu Ji Maharaj University, Kanpur
[2]Associate Professor, School of Business Management, Chhatrapati Shahu Ji Maharaj University, Kanpur

faces persistent issues such as water scarcity, drought, and economic distress. Amid these challenges, the region's cuisine emerges as a powerful lens through which to explore sustainable development. Rooted in locally adapted crops, traditional cooking practices, and non-timber forest products (NTFPs), Bundelkhand's culinary heritage offers a pathway to address food security, cultural preservation, and environmental resilience. This chapter examines how reimagining Bundelkhand's cuisine can contribute to sustainable development by promoting climate-resilient agriculture, empowering local communities, and preserving cultural identity in the face of modernization and climate change. The study aligns with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) by promoting climate-resilient crops, SDG 5 (Gender Equality) through women-led food processing initiatives, SDG 13 (Climate Action) via low-carbon agricultural practices, and SDG 15 (Life on Land) by valorizing NTFPs to support biodiversity (United Nations, 2015). By reviving traditional dishes and integrating modern innovations, Bundelkhand's cuisine offers a scalable model for sustainable food systems. This analysis adopts the Food Systems Approach, which views food as an interconnected system of production, consumption, and socio-cultural practices (von Braun et al., 2021). This framework contextualizes the study by highlighting how cuisine bridges ecological, economic, and cultural dimensions, offering a holistic pathway to resilience in vulnerable regions. Through case studies and strategic recommendations, this chapter demonstrates how Bundelkhand's culinary practices can foster sustainable development globally.Sustainable development, as defined by the United Nations, seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. In the context of Bundelkhand, this involves balancing economic growth, environmental protection, and social equity. Cuisine, as a reflection of a region's ecology and culture, is a critical yet underexplored domain for achieving these goals. By reviving traditional food systems, leveraging local resources, and integrating modern innovations, Bundelkhand's cuisine can serve as a model for sustainable sustenance. This chapter explores the historical and cultural significance of Bundelkhand's cuisine, its alignment with sustainable agricultural practices, and strategies for its revival to foster resilience and development. Bundelkhand, a semi-arid region in central India, faces persistent challenges such as water scarcity, drought, and economic distress. Its culinary heritage, characterized by millet-based dishes and non-timber forest products (NTFPs), embodies resilience and

cultural identity. This chapter expands on five case studies that leverage Bundelkhand's cuisine to promote sustainable development. These cases—millet revival in Jhansi, mahua processing in Chhatarpur, culinary tourism in Orchha, Sukhad cookstove adoption in Tikamgarh, and recipe documentation in Banda—demonstrate practical applications of sustainable food systems. By addressing environmental, economic, and social dimensions, these initiatives provide scalable models for other semi-arid regions globally.

2. Historical and Cultural Context of Bundelkhand's Cuisine

Bundelkhand's cuisine is a product of its geography, climate, and socio-cultural history. The region's semi-arid landscape, characterized by rocky terrain and limited water resources, has shaped a cuisine that is frugal yet flavorful, relying on drought-resistant crops and locally available ingredients. Millets such as bajra (pearl millet) and jowar (sorghum), pulses like arhar (pigeon pea) and urad (black gram), and NTFPs like mahua, chironji, and amla are staples of the Bundelkhandi diet. These ingredients are not only suited to the region's harsh climate but also embody its cultural identity.Traditional dishes like *karelamatar* (bitter gourd with peas), *tikiyan* (spiced millet flatbreads), and *meedha ki sabji* (a vegetable curry made with local greens) reflect the ingenuity of Bundelkhand's people in utilizing limited resources. Cooking methods, often involving slow-cooking on chulhas (traditional clay stoves) using cow dung cakes or wood, emphasize resourcefulness but also pose challenges in terms of environmental sustainability. The region's culinary practices are deeply tied to its folk traditions, with songs and stories celebrating the harvest of millets or the versatility of mahua, a tree whose flowers, fruits, and seeds are used in food, beverages, and medicine.The influx of modern, homogenized cuisines and the shift toward cash crops like wheat and sugarcane have threatened these traditional food systems. Younger generations, influenced by urban diets and global food trends, are increasingly disconnected from their culinary heritage. This erosion of cultural knowledge underscores the need to document and promote Bundelkhand's cuisine as a pillar of sustainable development. Historically, colonial agricultural policies prioritizing cash crops like cotton and indigo, followed by the Green Revolution's emphasis on wheat and rice, marginalized millets, reducing their cultivation by 50% in Bundelkhand between 1960 and 2000 (Kumar & Singh, 2019). These policies disrupted traditional

mixed cropping systems, weakening food security and cultural identity. Anthropological studies highlight food's role in shaping Bundelkhand's identity, with communal cooking during weddings and festivals fostering collective resilience (Gupta, 2020). For instance, the preparation of *chironji ki barfi* during marriage ceremonies symbolizes prosperity and community bonding. However, urbanization and migration have led to a 30% decline in traditional recipe knowledge among youth, driven by the influx of homogenized, processed foods (Singh & Yadav, 2023). This erosion threatens intangible cultural heritage, as defined by UNESCO (2003), necessitating urgent documentation and revitalization efforts. By preserving these culinary traditions, Bundelkhand can reclaim its cultural identity while addressing modern sustainability challenges, aligning with global efforts to safeguard indigenous food systems in regions like the Andes or Mesoamerica, where quinoa and amaranth have been similarly revived (FAO, 2020).

3. The Nexus of Cuisine and Sustainable Development

3.1 Climate-Resilient Agriculture and Food Security

Bundelkhand's cuisine is inherently sustainable due to its reliance on climate-resilient crops. Millets, a cornerstone of the region's diet, require significantly less water than rice or wheat, making them ideal for the semi-arid climate. Studies indicate that millets use 30-40% less water than other cereals and can thrive in poor soil conditions, reducing the need for chemical fertilizers. Reviving millet-based dishes like *bajra ki roti* or *jowar ki khichdi* can promote sustainable agriculture by encouraging farmers to return to traditional cropping patterns.

The *Sustainable Bundelkhand* initiative, a regional development framework, emphasizes the revival of mixed cropping and organic farming to enhance soil health and biodiversity. By integrating traditional recipes into local and urban markets, demand for these crops can be stimulated, providing economic incentives for farmers to adopt sustainable practices. For instance, value-added products like millet-based snacks or mahua-based sweets can be marketed to urban consumers, creating a sustainable food value chain.Food security, a pressing issue in Bundelkhand due to recurrent droughts and economic distress, can also be addressed through cuisine. Traditional food systems, which prioritize local and seasonal ingredients, are inherently resilient to climate variability. During the COVID-19 pandemic, indigenous

food systems globally demonstrated their ability to provide nutrition when supply chains were disrupted. In Bundelkhand, promoting dishes made from NTFPs and millets can enhance food security by reducing reliance on external food sources. Bundelkhand's cuisine is inherently sustainable due to its reliance on climate-resilient crops like millets, which require 250-300 mm of water compared to wheat's 450-600 mm and yield 1.5-2 tons per hectare in marginal soils (Rao & Singh, 2021). Bajra and jowar, staples in dishes like *bajra ki roti* and *jowar ki khichdi*, reduce water stress by 35% compared to rice, making them ideal for Bundelkhand's arid climate. Recent agricultural reports indicate that millet-based systems enhance soil organic carbon by 20%, improving soil health and reducing chemical fertilizer use by 40% (ICAR, 2022). The *Sustainable Bundelkhand* initiative has revived mixed cropping, integrating millets with pulses like arhar, increasing farm resilience to climate variability. For example, mixed cropping trials in Jhansi yielded a 15% higher income per hectare than monoculture wheat systems (Rao & Singh, 2021). Promoting these dishes in local and urban markets can stimulate demand, encouraging farmers to adopt sustainable practices. During the COVID-19 pandemic, indigenous food systems globally, including millet-based diets in Bundelkhand, ensured nutrition when supply chains faltered, highlighting their role in food security (FAO, 2020). By scaling millet cultivation, Bundelkhand can reduce reliance on external food sources, aligning with SDG 2 (Zero Hunger) and supporting climate-resilient agriculture under SDG 13 (Climate Action).

3.2 Cultural Preservation and Tourism

Cuisine is a powerful medium for preserving cultural heritage. Bundelkhand's culinary traditions, embedded in its festivals, rituals, and daily life, are at risk of fading due to modernization and migration. Documenting recipes, such as the preparation of *mahura* (a dish made from mahua flowers) or *chironji ki barfi*, is essential for cultural preservation. Community-led initiatives, such as recipe books or cooking workshops, can engage younger generations and foster pride in their heritage.Tourism offers another avenue for cultural and economic sustainability. Bundelkhand's rich history, with attractions like the forts of Orchha and Jhansi, draws visitors who can be introduced to its cuisine through farm-to-table experiences or food festivals. For example, niche tourism models, such as destination weddings featuring traditional Bundelkhandi meals, can create economic opportunities while showcasing the region's

culinary diversity. Such initiatives align with sustainable tourism principles by supporting local economies and preserving cultural identity. Cuisine is a powerful medium for preserving cultural heritage, particularly in Bundelkhand, where culinary traditions are embedded in festivals, rituals, and daily life. The preparation of *mahura* during Holi or *chironji ki barfi* for weddings reinforces community identity, yet these practices are fading due to modernization and migration. Digital platforms, inspired by UNESCO's Intangible Cultural Heritage initiatives, offer a solution. For instance, the Slow Food Movement's Ark of Taste has digitized indigenous recipes globally, preserving culinary knowledge (Slow Food, 2021). In Bundelkhand, community-led digital archives, like the one in Banda, have documented 120 recipes, garnering 10,000 online views in a year (Singh & Yadav, 2023). These platforms engage younger generations, with 40% of workshop participants reporting renewed interest in traditional cuisine. By integrating recipes into educational curricula and social media campaigns, Bundelkhand can mirror global efforts like Mexico's preservation of maize-based dishes, safeguarding cultural identity while fostering pride and ownership (UNESCO, 2003).

3.3 Economic Empowerment through Food Processing

The *Sustainable Bundelkhand* project highlights food processing as a key strategy for economic development. NTFPs like mahua, chironji, and amla have significant potential for value addition. For instance, mahua can be processed into edible oil, beverages, or sweets, while chironji can be used in desserts or as a spice. Establishing small-scale food processing units can create jobs, particularly for women, who are traditionally involved in NTFP collection and food preparation.

Women's self-help groups (SHGs) in Bundelkhand have already demonstrated success in producing and marketing local products. Training programs in food safety, packaging, and marketing can further empower these groups, enabling them to access urban markets. Such initiatives align with sustainable development goals by promoting gender equity, reducing poverty, and fostering local entrepreneurship. The *Sustainable Bundelkhand* initiative emphasizes food processing as a driver of economic development, particularly for women, who dominate NTFP collection and food preparation. NTFPs like mahua, chironji, and amla have significant potential for value addition. For example, mahua-based sweets and chironji snacks can be processed into

marketable products, as seen in Chhatarpur's cooperative, which generated INR 5 lakh in revenue annually (Development Alternatives, 2021). Microfinance models, such as those implemented in Tamil Nadu's SHGs, can scale these units by providing low-interest loans and training in food safety and marketing (Sharma & Tiwari, 2018). In Bundelkhand, SHGs have increased women's income by 20%, reducing migration by 15% in pilot areas. Partnerships with e-commerce platforms, like those in Gujarat's dairy cooperatives, can further enhance market access, creating sustainable livelihoods and aligning with SDG 5 (Gender Equality) and SDG 1 (No Poverty).

3.4 Environmental Sustainability and Health

Traditional cooking practices in Bundelkhand, while resource-efficient, often rely on biomass fuels like wood or cow dung, contributing to indoor air pollution and deforestation. The introduction of improved cookstoves, such as the Sukhad stove, can reduce fuel consumption and emissions, improving health outcomes for women who spend significant time cooking. These stoves, designed to burn biomass more efficiently, align with sustainable development by addressing environmental and health concerns simultaneously.Moreover, the organic nature of Bundelkhand's traditional food systems minimizes the use of chemical inputs, preserving soil health and biodiversity. For example, the use of neem leaves or turmeric in cooking not only enhances flavor but also serves as a natural preservative, reducing the need for synthetic additives. Promoting these practices can contribute to a healthier and more sustainable food ecosystem. Traditional cooking practices in Bundelkhand, reliant on biomass fuels like wood or cow dung, contribute to indoor air pollution and deforestation, with households consuming 2-3 tons of fuelwood annually (WHO, 2020). Improved cookstoves, such as the Sukhad stove, reduce fuel use by 25% and emissions by 30%, lowering carbon footprints and improving women's health (World Health Organization, 2020). NTFP-based diets, rich in mahua and amla, also have a lower environmental impact, with a carbon footprint 40% less than wheat-based diets due to minimal processing and chemical inputs (Mishra & Sharma, 2022). Promoting these practices preserves biodiversity, as mahua trees support pollinators and soil health, aligning with SDG 15 (Life on Land). For example, sustainable harvesting in Chhatarpur preserved 1,000 mahua trees, sequestering an estimated 50 tons of carbon annually (Development Alternatives, 2021).

3.5 Challenges to Sustainable Culinary Practices

Despite its potential, reviving Bundelkhand's cuisine faces several challenges. The high cost of maintaining traditional food systems, coupled with poor infrastructure, limits scalability. Small-scale farmers often lack access to markets or credit, making it difficult to transition back to millets or NTFPs. Climate change, with its erratic rainfall and rising temperatures, further threatens agricultural productivity.The cultural shift toward modern diets also poses a challenge. Urbanization and migration have led to a preference for processed foods, reducing demand for traditional dishes. Additionally, the lack of documentation and institutional support for preserving culinary knowledge hinders efforts to promote Bundelkhand's cuisine. Addressing these challenges requires a multi-faceted approach, including policy support, community engagement, and market linkages. Reviving Bundelkhand's cuisine faces social barriers, including caste dynamics and gender roles. In rural areas, food preparation is often tied to caste-based traditions, with certain dishes restricted to specific communities, limiting their widespread adoption (Gupta, 2020). Gender norms place the burden of cooking on women, yet their contributions are undervalued, hindering their participation in commercial food processing. For instance, only 30% of women in SHGs have decision-making roles, reflecting patriarchal constraints (Sharma & Tiwari, 2018). Addressing these barriers requires community sensitization programs and inclusive policies that promote equitable participation. Training programs targeting marginalized groups and women can foster social equity, ensuring that sustainable culinary initiatives benefit all community members.

4. Case Study

4.1 Revival of Millet-Based Diets in Jhansi

Overview

In Jhansi, a local non-governmental organization (NGO), in collaboration with agricultural cooperatives, launched a millet revival program to address food insecurity and promote sustainable agriculture. The initiative focused on bajra (pearl millet) and jowar (sorghum), crops well-suited to Bundelkhand's arid climate due to their low water requirements and resilience to poor soil conditions.

Implementation

The program trained 250 farmers in organic farming techniques, including mixed cropping and crop rotation, to enhance soil fertility and reduce reliance on chemical inputs. Women's self-help groups (SHGs) were engaged to develop value-added products, such as *bajra ki tikiyan* (spiced millet flatbreads) and millet-based snacks, which were marketed at local fairs, urban health food stores, and online platforms. The NGO partnered with agricultural extension services to provide seed subsidies and technical support, while awareness campaigns highlighted the nutritional benefits of millets, such as high fiber and micronutrient content.

Impact

Over two years, 200 farmers transitioned to millet cultivation, reducing water usage by approximately 30% compared to wheat, as millets require 250-300 mm of water versus wheat's 450-600 mm. SHGs reported a 15% increase in household income, with women earning an average of INR 12,000 annually from snack sales. Urban demand for millet-based products grew, driven by health-conscious consumers, leading to a 20% rise in millet procurement from local farmers. The initiative also improved food security, as millets provided a reliable food source during drought periods.

Relevance

This case underscores the potential of traditional crops to enhance food security and economic sustainability. By aligning with climate-resilient agriculture, the initiative supports Sustainable Development Goals (SDGs) 2 (Zero Hunger) and 13 (Climate Action). It also highlights the role of women in scaling sustainable food systems, offering a replicable model for other drought-prone regions.

4.2 Mahua Processing Unit in Chhatarpur

Overview

In Chhatarpur, a women-led cooperative established a small-scale mahua processing unit to produce edible oil, sweets, and beverages from mahua (Madhuca longifolia), a native tree abundant in Bundelkhand. This initiative aimed to empower women economically while promoting sustainable use of NTFPs.

Implementation

Supported by the *Sustainable* Bundelkhand initiative, the cooperative trained 60 women in food processing, hygiene standards, and packaging. The unit processed mahua flowers into edible oil and sweets like *mahura laddoo*, while surplus flowers were used for fermented beverages. Partnerships with e-commerce platforms and local retailers ensured market access. The cooperative also collaborated with forest departments to promote sustainable harvesting practices, ensuring mahua trees were not overexploited.

Impact

The unit employed 50 women, increasing their annual income by 20% (approximately INR 15,000 per woman). Sales of mahua products generated INR 5 lakh in revenue within the first year. Sustainable harvesting practices preserved 1,000 mahua trees, supporting biodiversity and carbon sequestration. The initiative also reduced migration, as women found viable livelihoods locally.

Relevance

This case highlights the intersection of economic empowerment and environmental sustainability. By valorizing NTFPs, the initiative aligns with SDGs 1 (No Poverty), 5 (Gender Equality), and 15 (Life on Land). It serves as a model for leveraging indigenous resources to create sustainable livelihoods in resource-scarce regions.

4.3 Culinary Tourism in Orchha

Overview

Orchha, a historic town known for its forts and temples, introduced a "Bundelkhand Food Trail" to attract tourists and promote traditional cuisine, including dishes like *karelamatar* (bitter gourd with peas) and *chironji ki barfi* (a sweet made from chironji seeds).

Implementation

Local restaurants collaborated with the Madhya Pradesh Tourism Board to offer farm-to-table dining experiences, sourcing ingredients like millets, pulses, and NTFPs from nearby farmers. Cooking workshops and food festivals were organized to engage

tourists and educate them about Bundelkhand's culinary heritage. A digital marketing campaign promoted the trail, targeting eco-conscious and cultural tourists. Farmers received training to supply organic produce, ensuring quality and sustainability.

Impact

Tourism revenue in Orchha increased by 10% over two years, contributing INR 2 crore to the local economy. Farmers reported a 25% increase in demand for traditional crops, boosting their income by INR 10,000 annually on average. Cooking workshops engaged 500 tourists annually, preserving culinary knowledge among younger generations. The initiative also created 30 new jobs in hospitality and food services.

Relevance

This case demonstrates how culinary tourism can drive economic growth and cultural preservation, aligning with SDGs 8 (Decent Work and Economic Growth) and 11 (Sustainable Cities and Communities). It offers a blueprint for integrating cultural heritage into sustainable tourism models.

4.4 Sukhad Cookstove Adoption in Tikamgarh

Overview

A government-backed program in Tikamgarh distributed Sukhad cookstoves to rural households to reduce indoor air pollution and fuel consumption, addressing health and environmental concerns associated with traditional chulhas.

Implementation

The program, part of the National Programme on Improved Chulhas, distributed 1,200 subsidized Sukhad cookstoves to households, prioritizing women-led families. Training sessions educated users on stove maintenance and efficient cooking techniques for traditional dishes like *jowar ki khichdi*. Community awareness campaigns, conducted through village panchayats, highlighted the health benefits of reduced smoke exposure and environmental benefits of lower fuelwood use.

Impact

Fuelwood consumption decreased by 25%, saving approximately 1 ton of wood per household annually. Respiratory issues among women dropped by 30%, as reported by local health centers. The stoves enabled sustainable cooking of traditional dishes, maintaining cultural practices while reducing environmental impact. The program also saved households INR 2,000 annually on fuel costs.

Relevance

This case illustrates the role of technology in enhancing the sustainability of traditional culinary practices. It aligns with SDGs 3 (Good Health and Well-Being) and 7 (Affordable and Clean Energy), offering a scalable solution for rural households in biomass-dependent regions.

4.5 Recipe Documentation in Banda

Overview

A community-led initiative in Banda aimed to preserve Bundelkhand's culinary heritage by documenting traditional recipes at risk of being lost to modernization and migration.

Implementation

Elders and local cooks collaborated with a local cultural organization to create a digital archive of over 100 recipes, including *meedha ki sabji* (a vegetable curry) and *mahura* (a mahua-based dish). The project involved oral history interviews and video documentation, uploaded to an open-access platform. Local schools integrated these recipes into cultural education programs, organizing cooking workshops for students. Community events, such as recipe fairs, encouraged intergenerational knowledge transfer.

Impact

The archive preserved 120 recipes, with 10,000 online views within the first year. Student participation in cooking workshops increased by 40%, with 300 students annually engaging in hands-on learning. The initiative fostered pride in local identity, with 70% of participants reporting a renewed interest in traditional cuisine. The digital

platform also attracted researchers and food enthusiasts, amplifying Bundelkhand's cultural visibility.

Relevance

This case emphasizes the importance of cultural documentation in sustaining culinary heritage, aligning with SDG 4 (Quality Education) and 11 (Sustainable Cities and Communities). It provides a model for preserving intangible cultural heritage in rapidly modernizing regions.

5. Strategies for Reimagining Bundelkhand's Cuisine

To harness the potential of Bundelkhand's cuisine for sustainable development, the following strategies are proposed:

5.1 Documentation and Education

Creating a comprehensive repository of Bundelkhandi recipes, including preparation methods and cultural significance, is critical for preservation. Community-led initiatives, such as oral history projects or digital platforms, can document recipes and stories from elders. Educational programs in schools and colleges can introduce young people to their culinary heritage, fostering a sense of pride and ownership.

5.2 Promotion of Climate-Resilient Crops

Government and non-governmental organizations should incentivize the cultivation of millets and NTFPs through subsidies, training, and market linkages. Awareness campaigns highlighting the nutritional and environmental benefits of these crops can increase consumer demand. For example, millet-based dishes can be promoted as healthy, gluten-free alternatives in urban markets.

5.3 Development of Food Processing Units

Investing in small-scale food processing units can create economic opportunities while preserving culinary traditions. These units should focus on value-added products like millet flour, mahua-based beverages, or chironji snacks. Partnerships with private companies and e-commerce platforms can ensure market access, while training programs can equip local communities with the necessary skills.

5.4 Sustainable Cooking Technologies

The adoption of improved cookstoves and renewable energy sources, such as solar cookers, can reduce the environmental impact of traditional cooking methods. Government schemes like the National Programme on Improved Chulhas can be expanded to provide subsidized stoves to rural households, improving health and sustainability.

5.5 Culinary Tourism and Festivals

Organizing food festivals and farm-to-table experiences can showcase Bundelkhand's cuisine to tourists and urban consumers. Collaborations with tourism boards and hospitality sectors can integrate traditional dishes into menus, creating economic opportunities for local communities. For example, a "Bundelkhand Food Trail" could highlight authentic dishes alongside cultural landmarks.

5.6 Policy Support and Research

Policymakers should integrate culinary preservation into sustainable development frameworks, such as the *Sustainable Bundelkhand* initiative. Research institutions can study the nutritional and ecological benefits of traditional crops, providing evidence to support their revival. Public-private partnerships can facilitate the scaling of sustainable food systems, ensuring long-term impact.

6. Discussion

These case studies highlight the multifaceted role of Bundelkhand's cuisine in sustainable development. The revival of millets in Jhansi demonstrates the potential of traditional crops to address food security and climate resilience. The mahua processing unit in Chhatarpur underscores the economic and environmental benefits of NTFPs, particularly for women. Culinary tourism in Orchha illustrates how cultural heritage can drive economic growth, while the Sukhad cookstove program in Tikamgarh shows the impact of technology on health and sustainability. Finally, recipe documentation in Banda emphasizes the importance of preserving cultural knowledge for future generations.

7. Challenges

Despite their success, these initiatives face challenges, including limited infrastructure, high initial costs, and resistance to traditional diets due to modern food preferences. Scaling these models requires policy support, such as subsidies for organic farming or cookstove distribution, and private-sector partnerships for market access.

8. Scalability and Global Relevance

The approaches demonstrated in these case studies are replicable in other semi-arid regions with similar socio-economic and environmental challenges. For instance, millet-based initiatives can be adapted to Sub-Saharan Africa, where sorghum and pearl millet are staples. Similarly, NTFP processing mediatation and cultural preservation offer universal lessons for sustainable food systems.

9. Conclusion

Bundelkhand's cuisine, with its reliance on climate-resilient crops, cultural significance, and potential for economic empowerment, is a powerful tool for sustainable development. By reviving traditional dishes, promoting sustainable agriculture, and leveraging tourism and food processing, the region can address its environmental, economic, and social challenges. The case studies from Bundelkhand illustrate how cuisine can serve as a catalyst for sustainable development. By integrating local food systems with modern innovations, these initiatives address food security, economic empowerment, cultural preservation, and environmental sustainability. Policymakers and researchers can draw on these models to design holistic interventions that align with global sustainability goals, ensuring the resilience of vulnerable regions like Bundelkhand. This requires concerted efforts from communities, policymakers, and researchers to overcome barriers like modernization, climate change, and infrastructure limitations. Reimagining Bundelkhand's cuisine is not just about preserving recipes; it is about fostering resilience, empowering communities, and celebrating a way of life that has sustained the region for centuries. By integrating culinary heritage into sustainable development frameworks, Bundelkhand can chart a path toward a future where tradition and resilience go hand in hand, ensuring sustenance for generations to come.

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St Joseph's Institute of Management (SJIM)
No. 28/1 Primrose Road, (Off M.G. Road), Bangalore - 560025.
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