

# Sustainable Development Goals: Lean Entrepreneurship and Green Entrepreneurship

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**Abstract:** This study investigated the moderating climax of sustainable development goals between the correlates of lean entrepreneurship and green entrepreneurship. The study adopted correlation design, cross-sectional cohort design and ex-post facto design. The study used non-proportionate stratified random sampling technique, purposive sampling technique and multi-stage cluster random sampling technique. Cohort of entrepreneurs was selected for the authenticity of the study. A total population of 320 and sample size of 175 was determined using Krejcie and Morgan Table at 0.05 level of significance. 175 copies of questionnaire were administered, only 162 were deemed fit after processing, retrieval, coding and cleansing of data. The instruments were validated with experts of entrepreneurship, also using various approach to authenticate the reliability, the outcome was Spearman-Brown equal length is 0.964 (96.40%) and Guttman Split-Half Coefficient is 95.10 (0.951). Three research questions and three hypotheses were raised which was tested with OLSM, logistic regression analysis and KMO/Bartlett's test for the sampling adequacy on data appropriateness and sphericity respectively via SPSS 25 version. From the findings, lean entrepreneurship positively correlates the green innovation and green product. In conclusion, the apriori expectations were found to be positive outcomes because of the correlations among the moderating variable, explanatory variable and response variables. Hence, the regression model revealed that the alternate hypotheses were accepted, unlike the null hypotheses. Based on the findings and conclusion, this study contributes to the knowledge that lean thinking is perceived as a path to product innovation and green product; more so, the 3Ps people profit and planet are simultaneous with sustainability, survival and success. It could be recommended that lean entrepreneurs should develop and design an analytical framework to synchronized lean thinking principles with green product and innovation. Entrepreneurs should always facilitate continuous improvement on devising green innovation towards the sustainability, survival and success. Additionally, lean entrepreneurship and green entrepreneurship aims should focus on customer care, safety and satisfaction.

**Keywords:** Lean Entrepreneurship, Lean Culture, Kaizen Culture, Green Entrepreneurship, Lean Thinking, Green Product, Green Innovation, Sustainable Development Goals

## I. INTRODUCTION

The ark of the dynamism from the millennium development goals triumphant to the sustainable development goals pointed to the optimum proficiency and beneficial utilization of the people, planet and profit.

However, in the eyes of entrepreneurs are sustainability, survival and success respectively. It boils down to the consciousness of how entrepreneurs dramatized in the environment. The consciousness of environmentalism by entrepreneurs in the process of industrialization needs urgent attention globally especially in Africa. With the crush that various Africa countries has encountered in their economic and financial system over the years, entrepreneurial activities in the micro-firms and macro-firms has been seen as major threat towards boosting business performance and excellence.

But, considering the climate change, environmental degradation, pandemic, hazard, perils, oil spillage, black soot, natural disaster, forms of pollution, radiation element, ozone layer depletion, non-replenishment of natural resource, turbulent global warming and contamination, the planet is already posing threat and signal of disastrous danger ahead. Hence, to avert this catastrophe ahead, entrepreneurs ought to adopt the green attributes. The application, adoption and adaptability of this attribute calls for the concept of green entrepreneurship (Geoffrey, 2017).

The dangerous production process engages by most entrepreneurs and illegal merchandizing activities in pursuit of profit maximization instead of humanized value creation and wealth creation is not helping. The power tussle and reckless competitive parity to be the market leadership has become a threat to our livelihood, wellbeing and wellness. Rather these reckless activities have traumatized and paralyzed the micro-macro activities that sustain and survived the sustainable development goals (Ovharhe, 2022).

The engine house of micro-macro firms, economic growth and sustainable development goals lies on the heart of the small and medium-sized enterprises (SMEs) and large-scale enterprise (Ahmad, Mahmood, Ariza-Montes & Han, 2021). Entrepreneurs are needed to lubricate the micro-macro enterprise at all level of productivity and investment opportunities. If the life stream of the micro-macro enterprise is allowed to stop breathing, the enterprise as an organism might bleed, shrinks and dies. This is the say that the product life cycle and enterprise life cycle depend on entrepreneurial sustainability, survival and success.

Invoking the sustainability, survival and success (3Ss) is the life stream of green entrepreneurship, just as the people,

planet and profit (3Ps) steams the environmentalism. This steams the life cycle of the entrepreneurial process.

Thus, algebraically: 3Ss + 3Ps= Green Entrepreneurship

So: Sustainability x Survival x Success + Planet x People x Profit = Green Entrepreneurship

But entrepreneurs need to go green. The greener an entrepreneur becomes the more livelihood the enterprise would become. The context of green application expedites safety, conducive and green environment. Entrepreneurs are known for her innovation, risk culture, burden bearer, creativity, ideology, brainstorming and invention. When application of green entrepreneurship comes to the light, there would be green supply chain management (GSCM), green logistics, green marketing, green jobs, green production, green product, green process, green engineering, green manufacturing, green recycling, green waste management system and lot more (Gibbs & O'Neill, 2014).

When life is green, it's better for all. This means there should be green consciousness by entrepreneurs, intrapreneurs, serial entrepreneurs, light entrepreneurs, co-entrepreneurs, ultrapreneurs, engineering entrepreneurs, hybrid entrepreneurs, infopreneurs, therapeutic entrepreneurs and co-preneurs (Ovharhe, 2022). If green entrepreneurship is adopted and practice by all fragment of entrepreneurs, they would be seen as green champio-preneur (or champiopreneur) to save the environment (Chibuike, Ovharhe & Abada, 2022).

Green entrepreneurship is the process of applying environmentalism into the features and characteristics of entrepreneurship with the aid of sustainability, survival and success of the enterprise and society. This means that green entrepreneurship takes into cognizance that the entrepreneurial risk, innovation, culture, attitude, creativity and ventures should be green and environmental friendly (Delafrooz & Moghaddam, 2017).

More so, the green entrepreneurs should also ensure that their practices on various input and output strategies should be co-friendly to the environment. This involves safety from the land and labour to the final production stages. The process, product, brand, ergonomic, and administration should always have the green conscience attributes of protecting the land, labour, consumers, environment and society at large. With the awareness and knowledge about environmentalism and entrepreneurialism, green entrepreneurship is becoming vastly penetrating the entire aspect of human life (Affolderbach & Krueger, 2017). Customers and client in the market and enterprise are becoming more conscious about green activities. As people need better life service quality, they also want green product, green production techniques and green design so their life security on consumption will be guarantee (de Bruin, 2016). One of the major features of an entrepreneur is the ability to be innovative. This has led to the integration of green entrepreneurship with product innovation, process innovation, market innovation, technology innovation, service innovation and market innovation. Hence, the synopsis of this could be known as green innovation and green product.

Green entrepreneurship is the father of green innovation and green product. For green entrepreneurship to be achieved so that green innovation and green product can be fully implemented, a new wave concept that can address the bottleneck on how to reduce wastage, boost continuous improvement, maximum customer satisfaction, increase profitability, effective timing and speed efficiency need to be introduced. Also, this will mitigate the backdrop of the green entrepreneurship adoption by the enterprise in the environment. This concept is the principles of lean entrepreneurship (Chibuike *et al.*, 2022).

Lean entrepreneurship starts by identification of customer's needs which ends with the pull system and continuous improvement (Ries, 2011). If this process is applied on green entrepreneurship, there will be maximum effectiveness and efficiency in the entrepreneurialism and environmentalism.

Identification of customer needs is vital issues every entrepreneur should focus on. Without proper definite process to identified customer needs, there will not be any satisfaction derived at the endpoint after patronage that would obstruct the value chain. The essence of identifying customer needs is to create, develop and add value that addresses customer's need which will yield satisfaction. The value added concept created by the enterprise that enable customer to derived satisfaction are problem solving measures capable of providing continuous improvement, workflow, value chain, value stream mapping and pull system. This constitutes a dual benefit among the enterprise, clients and stakeholders. Any phenomenon that does not support this concept towards adding value could be seen as waste (Shafiq & Soratana, 2020). Hence, by reducing waste, time, profit, resource and man-hours will be well utilized efficiently and effectively. For entrepreneurs to achieve this process of waste management and resource efficiency to be maximized towards enterprise benefits and mission, the concept of lean entrepreneurship should be practices rapidly.

### 1.1. Objective of the study

1. To examine the correlates between lean thinking and green innovation
2. To investigate the correlates between of lean thinking and green product
3. To analyze the sustainable development roles in moderating the correlates between lean entrepreneurship and green entrepreneurship.

### 1.2. Research Questions

1. To what extent does lean thinking correlates green innovation?
2. To what extent does lean thinking correlates green product?
3. To what extent does sustainable development moderates the correlates between lean entrepreneurship and green entrepreneurship?

### 1.3. Hypotheses

- H<sub>01</sub>:** Lean thinking does not significantly correlate green innovation
- H<sub>02</sub>:** Lean Thinking does not significantly correlate green product
- H<sub>03</sub>:** Sustainable development goals do not significantly moderate the correlates between lean entrepreneurship and green entrepreneurship.

## II. CONCEPTUAL FOUNDATION

### 2.1.1. Concept of Lean Entrepreneurship

The very essence of entrepreneurship is to innovate, create, fabricate, lubricate and invent the current and future needs to satisfied clients and customers. Entrepreneurs has the capability to develop pulling string which has the tendencies to create value attachable to customer needs at the right timing, pricing, quality, logistics and specification. This is what lean entrepreneurship is about on value creation and wealth creation (Sahoo, 2019). This means a lean entrepreneur is an innovator, creator, fabricator, lubricant and inventor of anticipating customer needs with active feasibility.

Lean entrepreneurship is customer focus in line with the lean thinking, lean culture and lean improvement principles (Chibuike, Ovharhe and Amara, 2022). Lean entrepreneurship is totally in support of the lean methodology that click towards being customer focused of delivery value added virtue, waste banish of whatever that does not add value to the lean process with application of lean improvement. But, respect it a key factor to the customer value delivery. This enables the enterprise to match on continuous value creation and wealth creation.

Before starting a new enterprise or launching a new product the customer value should be respected by the entrepreneur. Lean entrepreneurship always put the customer at the first place to guide lean policy and decision making. Lean entrepreneurship major tasked is on responsibility and control measures to ensure the right product and added value is continuously innovated, created, invented, fabricated, lubricated, developed and transformed. The lean culture should be a preferred steppingstone to achieve the continuous process. No entrepreneur should indulge in risk taking without considering the lean entrepreneurship culture. The culture entails the entrepreneurial attitude, behavior and competence (Chibuike and Ovharhe, 2022).

Ries (2011) who was a driver of lean entrepreneurship argued that enterprise can have sustainability, survival and success if there is continuous innovation, invention, creation and development of radical ideas and lean philosophy (Ovharhe, Woko & Ezeocha, 2021). Most enterprise failed because they neglect lean entrepreneurship philosophy. Lean entrepreneurship brings radicalized and competitive advantage dynamism that dramatically changes the business philosophy especially in Africa. If Africans can adopt lean entrepreneurship philosophy there will be drastic changes in the enterprise function on level of profitability index, return

on investment, total revenue and return on capital employed. Lean entrepreneurship debunks unnecessary wastages, resources, manpower, cost, pilferage, obsolescence, demurrage, larceny and danger stock level.

Lean entrepreneurship lubricates and crystallized dying business with illuminations being focused at the customer resuscitated the bleeding-edge enterprise resilience (Khaw, Zailani, Iranmanesh & Heidari, 2019). Lean entrepreneurship is a therapy to business functions that cannot meet up its targeted profit (Lamaster, Hastings, Husch & Hooker, 2019); (Ovharhe, 2022). It is always act as moving stream to sustain the wealth, market and product function of an enterprise. Lean entrepreneurship is the revival of entrepreneur's dream, vision, passion and mission (Ovharhe, 2022). Leaning entrepreneurship is bailouts by fostering enterprise despise her high leverage or equity level on cost leadership, skimming the cream or penetration pricing and market leadership. This could be easily achievable because lean entrepreneurship operates like learning curve or improvement efficiency. Lean entrepreneurship nurture enterprise from the start-up point to the top leadership position.

#### 2.1.1.1. Lean Thinking

Lean thinking is a cracking code to penetrate the heart of the customer so as to create the right and desired value to customer. All entrepreneurs should develop the mindset of utilizing cracking code to be determining the optimistic specification of pulling needs and fine-tuning demand strategies towards actualizing customer taste and quality (Thangarajoo, 2015). This is necessary because lean thinking ensure respects for all stakeholders in the enterprise value system and supply chain, but most especially the customer that is the end user of the product.

The lean thinking is customer friendly, because they are lubricate and fuel to continuous improvement of value creation, quality, taste and time. Originating from the automobile industry, the approach has been used extensively in the manufacturing sector since the 1990s. Basically, lean manufacturing centered on the philosophy of continuously improving performances by systematically eliminating wastes in the enterprise merchandizing functions. Lean thinking handles the strategic and operational activities of service oriented firms, distribution and logistics firms, sales and marketing oriented firms, financial institutions and manufacturing firms (Chibuike & Ovharhe, 2022). Lean Thinking is at best in creating values for client and maximizing efficiency by reducing cost, saving time, increase productivity, controlling waste, continuous improvement and developing pulling customer's strings in the short term and long term.

#### 2.1.2. Green Entrepreneurship

Change is a very common occurrence which sometimes occurs in a cyclical manner or maybe sometimes in random order. In the same method, the customers' needs, wants, demands, desire and preferences are also varying. This change is not for a specific product category, but it exists product

segmentation. There are various reasons for these behavioral changes, like an increase in consumers' household income, environmental awareness or maybe because of change in VALS (values, attitude and lifestyles) (O'Neill & Gibbs, 2016). This change in consumer behavior generates a new market opportunity. So, to grab this market opportunity, the firms also need to implement some changes like new product development, market development, market extension, diversification, product redesign or changes in the marketing policies (Ovharhe, Woko & Ogolo, 2021). The enterprises, implementing green practices are in the business of generating profit at their merchandizing operations (Lathabhavan, 2021).

The term green entrepreneur is the combination of entrepreneurship and the environment. The green entrepreneur is the one, who cultivates green business with the help of green practices. A green entrepreneur consciously addresses an environmental or social problem/need through the understanding of entrepreneurial ideas (O'Neill & Gibbs, 2016). They penetrate the market by swapping conventional or traditional products. The objective of the green entrepreneur is not only serving the customer with their green products or services but also makes people aware of the green ecosystem. So the thought for the green entrepreneurship originates from the combination of the main features of the entrepreneurship itself innovation, risk, a brand new business idea, and the social and ecological engagement of those who do business (Vallaster, Kraus, Kailer & Baldwin, 2018).

In recent days, green entrepreneurs play a very important role in the enterprise growth and economic development of developing and developed nations and also treated as the driving force towards the change of consumer behavior in esteemed for launching, innovating, implementing and emerging new thoughts and for their rapid response to these changes and adaptability (Ovharhe & Igbokwe, 2021). Indeed, there is a crucial variance between the way of looking at green entrepreneurship in developed countries and developing countries. Developed countries and international organizations like the World Bank, UNCTAD, OECD, UNIDO, WTO and FAO incline to put maximum prominence on market opportunities and on the term green, while developing countries tend to emphasis more on market needs and on the term entrepreneurship (Dsouza, 2021). Overall, the outcome favors the sustainable development goals (Kulmaganbetova, Kozhakhmetov, Tlessova, Sharapayeva, Baimbetova, Kirdasinova & Mamutova, 2022).

#### 2.1.2.1. Green Innovation

Innovativeness is a life-wire of enterprise. Innovativeness is developing new invention from existing or non-existing concept. Innovativeness can occur as idea innovation, product innovation, process innovation, service innovation, market innovation, sales innovation, technology innovation, administrative innovation and lot more (Kemper, Hall & Ballantine, 2019). Innovation is a complex entity when it is synchronized with the concept of green that deals with environmental factors. Green innovation is about ensuring all

brand of innovation to be environment friendly (Affolderbach & Krueger, 2017). This pursuit is to make adequate reliability and validity of entrepreneurial innovation to follows the green protocol. Most entrepreneurs do not think about green innovation in new product development stages or when creating a prototype (O'Neill & Gibbs, 2016).

Green innovation considers factors without the use of toxic chemicals and hygienic conditions, recycled, reused and are biodegradable in nature, zero carbon footprint and zero plastic footprint. Green innovation should be symmetrical with green economy (Sze, 2018). If both are harmonized the environment bottlenecks and barriers from greed of business owners would be easily chatter. In business, greed or green do not correlate Vuorio, Puumalainen & Fellnhofer (2018). The reason most entrepreneurs do not integrate green on their business is because of greed. Greedy entrepreneurs pursue profit maximization at all cost, even when its detriment to customer, people and the planet. Entrepreneur that are environmentally friendly do adopt green wealth maximization. Entrepreneur can either be driven by green or greed. Thus, lean innovation is symmetrical to green innovation in the long term (Osman, Mamat & Ali, 2020).

#### 2.1.2.2. Green Product

Green product is a production (tangible and intangible) innovated, constructed, fabricated, designed, lubricated, invented and created to be environmentally friendly without threat to the livelihood of humanity. Green products are not detriment to the wellbeing and wellness of the enterprise supply chain management. Green product boost up life expectancy and quality of life. The customer, vendor, middlemen and task force are safe with the product attributes and features. Green product mitigates danger to the environment. It promotes the triple action of people, planet and profit preservation in the short-term and long-term. The life cycle of every green product should not pose a negation effect to the environment and ecological system. The life of every living thing such as plant or animal is very vital and should not be threaten by any absurd product that is not green to nature.

Entrepreneurs are mostly interested in value creation and wealth creation to satisfy the customer and organization respectively. Therefore, entrepreneurs should curtail banishing and regulating waste by using toxic-free ingredients, non-pollutant component in the process of value creation and wealth creation. Though, green product should be certified by regulated government agencies for standardization and control. The government agencies of any nation should always develop preservation and prevention to ensure equitable distribution of justice and fairness policy is the administrating of green entrepreneurship such as toxic chemical, pollution, degradation and carbon footprint.

#### 2.1.3. Lean Entrepreneurship and Green Entrepreneurship

Lean entrepreneurship is the process whereby, there is the culture by adding value that streams creating wealth pull system, customer satisfaction, process flow, continuous

improvement, maximizing profitability, time proficiency and reducing waste. The entire five fundamental principles that establish the concept of the lean are what constitute the lean entrepreneurship definition in this context (Shafiq & Soratana, 2020). These are entrepreneurial value creation, mapping of enterprise value stream, continuous enterprise-flow, entrepreneurial pull system and continuous improvement. Lean entrepreneurship encompasses the rejuvenation of existence, startup and non-existence enterprise to function effectively and efficiently with lean principles .

Every enterprise needs strategies and tactics to drives continuous improvement in the short term and long term in alignment with their merchandizing activities (Osman, Nordin & Rahman, 2020).. Lean entrepreneurship initiate strategies and tactics to support enterprise on how to startup a new firm, existing firm and non-existing firm. This could be done by the utilization of lean thinking, lean culture and lean philosophy.

Lean entrepreneurs should be green in practice and policy. Green entrepreneurship should have the footprint of tesla electric cars, eco-friendly dishwashers, green product certification and green seal in their process of operation (Bergset, 2015; Nieuwenhuis, 2018). This shows a strong correlate among the features and practices between lean entrepreneurship and green entrepreneurship. Lean entrepreneurship is systematically designed to banish waste with smooth production flow in the enterprise by continuously improvement. Green entrepreneurship rather focuses also in eliminating waste and product that are dangerous to the environment. It is interesting to know that lean entrepreneurship basic feature is respect for the customer, which is in alignment with the customer safety, preservation and caution. The synchronization of the lean entrepreneurship and green entrepreneurship ensure the safety of the customer in the process of value creation and wealth creation.

Green product in line with green innovation which anchors the point of mitigating lean defect and zero green safety tolerance (Vallaster *et al.*, 2018).

*Analytical Framework*

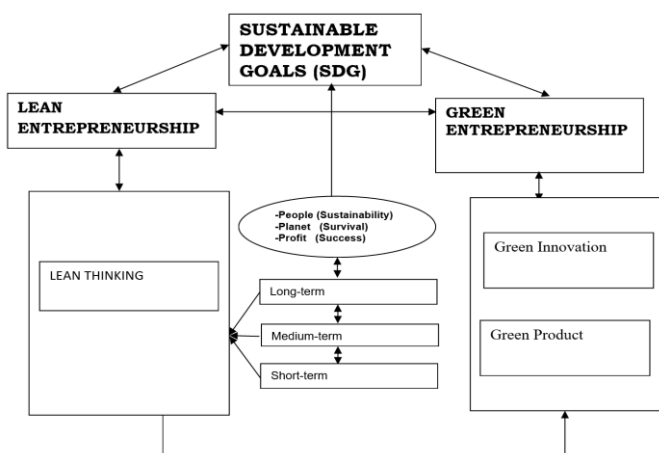


Fig 2.1: Analytical Framework of Lean Entrepreneurship And Green Entrepreneurship

The above analytical framework summarizes the discussion of the conceptual foundation in harmonizing the predictor and criterion variables being moderated by the sustainable development resultant effect in the long-term, medium-term and short-term. It also demonstrates the correlates among the explanatory variable and response variable.

*2.2. Paradigm Foundation*

*2.2.1. The Kaizen Culture (Kaizen Approach).*

The Kaizen approach could be developed with enterprise culture feature by harmonizing lean culture and risk culture (Chibuike & Ovharhe, 2022). The focus is on change for better to the acceptability of green and lean. Whenever, enterprise practice lean entrepreneurship and green entrepreneurship harmoniously is mitigating and banish waste threat in the environment. This leads to the discovery of electrical car, non-oxidized product and non-environmentally friendly kitchen utensils dangerous to human health.

Chibuike and Ovharhe (2022) foresee a situation where entrepreneurs need to augment Kaizen approach to Kaizen culture because of the risk culture attached to businesses that lacks risk committee in the enterprise as in the SMEs and micro enterprises. There is always a need to change for better, but certain risk must be involved by the entrepreneurs to be fruition. The essence of

Lean thinking, lean culture and lean improvement requires operational risk and strategic to fashion the change for better modalities. The Kaizen culture should be streamline from the top to the bottom executive of the enterprise. The vital role of the Kaizen culture has augmented to safe life of people, profitability of conglomerates and preservation of the planet.

As at 22 September 2022, Nancy Pelosi on her weekly press conference (Capitol Visitor Centre) make an historic statement the US government has save the planet with \$360 billion despite the process of feasible green job creation, green air, green water, green security and green health care for societal especially children. By Pelosi inscription, it could be concluded that the entire livelihood of human race cannot be sustainable, survive and successful with the green elements. To streamline excellency in green in the people, profit and planet, very aspect of human endeavor ought to synchronize the lean culture of green culture of adaptability, dynamism and agile (Ovharhe & Igbokwe, 2021).

The drivers and stimulants of the above should be focused on the lean entrepreneurship and green entrepreneurship. The habit of continuous improvement in green function is very important. It there is set back in the green in any country is as a result of the lack of lean application. Business either from the micro or macro angle needs to be lean and green to ensure sustainability, survival and success. This is an impact greatly on the people, profit and planet continuous improvement (Chibuike *et al.*, 2022). It is important to note that with the Kaizen culture applications, lean thinking is python to product innovation and green product.

### III. METHODOLOGY

This study investigated the moderating climax of sustainable development goals between lean entrepreneurship and green entrepreneurship. The study adopted correlation design, cross-sectional cohort design and ex-post facto design. The correlation design augments the systematic relationship among the explanatory and response variables, cohort design was employed because the study centred strictly on entrepreneurs with the spirit and trait within the sample frame, whereas ex-post facto design was integrated because the study was not manipulated or lobbied by the research teams to ascertain authenticity of degree of truth in the study. The study used non-proportionate stratified random sampling technique, purposive sampling technique and multi-stage cluster random sampling technique. Cohorts of entrepreneurs that operate business in cross borders within Africa from the period of year 2015 till date in Africa were selected for the study. Those selected must have done business in South Africa, Nigeria, Kenya and Egypt among others with the time frame prior to the activation of the millennium development goals/sustainable development goals transformation. Hence, 320 entrepreneurs were chosen and tutored on lean entrepreneurship and green entrepreneurship with syndicates and symposium method that met the criteria, while others were excluded. The Krejcie and Morgan Table were used to determine the sample size for the correlates research. From the table, at the population of 320 professionals, the sample size was 175 respondents. The sample of the study consists of 175 individuals' entrepreneurs which were drawn from the cohort in the Africa that are slated symposium and syndicates in lean thinking, green product and green innovation. Using 5 likert scale, self-design instrument was constructed for the explanatory variables and response variable. But the moderating variable instrument was coined from the early work of Ovharhe (2022). The split half reliability was used for the reliability, while the Spearman-Brown Prophecy Coefficient and Guttman Split-Half Coefficient were used to iron the reliability. Furthermore, to fashion the factor analysis on basis of the sphericity and sample adequacy, Kaiser-Meyer-Olkin (KMO) and Bartlett test were used for the factor analysis by means of authenticating the confirmatory principal component. Both KMO which measure the sampling adequacy and Bartlett test evaluate all available data together. A KMO value over 0.6 and a significance level for the Bartlett's test below 0.05 suggest there is substantial correlation in the data. This is to say that, KMO values between 0.8 and 1 indicate the sampling appropriateness of adequacy. KMO values less than 0.6 indicate the sampling is not adequate and that corrective action should be taken. Hence, variable correlate indicates how strongly a single variable is correlated with other variables. Thus, logistic regression analysis, ordinary least square method (OLSM) and descriptive statistics were used to determine the correlates among the explanatory variables and response variables.

The univariate analysis used the descriptive method to describe the mean, standard deviation, variance, skewness and

kurtosis. The bivariate hypotheses were tested using the regression analysis model with T test, Adjusted R square ( $R^2_{adj}$ ), collinearity diagnostic test, best Model Statistic whereas Eigenvalue ( $\lambda$ ) showing the matrix roots of the binomial characteristics. Also, the moderating variable was evaluated with Partial Correlation, while Adjusted R square ( $R^2_{adj}$ ) and Durbin Watson value were used to determine the best of fit among the variables.

In regression analysis, small (variance inflated factor) VIF values,  $VIF < 3$ , indicate low correlation among variables under ideal conditions. The default VIF cutoff value is 5; only variables with a VIF less than 5 will be included in the model. However, note that many sources say that a VIF of less than 10 is acceptable. Eigenvalues represent the total amount of variance that can be explained by a given principal component. They can be positive or negative in theory, but in practice they explain variance which is always positive. If eigenvalues are greater than zero, then it's a good sign. The tolerance is a reciprocal of the VIF which is certain at 1, Condition Index of above 15-30 calls for cautions that poses threat of collinearity. Thus, the SPSS version 25 was used for the data analysis.

#### *The Model Specification*

The Multiple Regression Model is appropriate for our analysis because all the variables in this study are measured in ordinal scale.

Where: Lean Thinking (LTK), Green Innovation (GIV) and Green Product (GPD) and Sustainable Development Goals (SDG).

#### *Algebraic Expression Equations*

$$GIV_t = f(LTK) \dots \dots \dots (1a)$$

$$GPD_t = f(LTK) \dots \dots \dots (1b)$$

#### *Linear Expression Equations*

$$GIV_t = a_0 + a_1(LTK_t) + U_t \dots \dots (2a)$$

$$GPD_t = a_0 + a_1(LTK_t) + U_t \dots \dots (2b)$$

It is important to note that the proxies can also be express in simple linear equation during data analysis

#### *Apriori Expectation of Variables in the Model*

The variables in the model comprises of the variable among the lean entrepreneurship and green entrepreneurship. The lean entrepreneurship proxy is lean thinking, whereas the green entrepreneurship proxies' are green product and green innovation. Hence, the moderating variable is sustainable development goals. The subscript "t" represents the time period, where "a<sub>0</sub>" is the intercept and "a" the proxies, while sustainable development goals is the  $u_t$

$a_0$  is the intercept

$a_1, a_2, a_3, a_4$  are parameter estimates

$u_t$  is an uncorrelated stochastic error term at time t

A priori it is expected that there will be a significant correlates among the variables for Lean Thinking, Green Innovation, Green Product and Sustainable Development Goals i.e.  $a_1 > 0$ ,  $a_2 > 0$ ,  $a_3 > 0$  and  $a_4 > 0$ .

IV. DATA ANALYSIS, RESULTS AND DISCUSSIONS

Since, the split-half techniques were applied to determine the reliability by sub-cohort with entrepreneurs, the Spearman-Brown Prophecy and Guttman Split-Half Co-efficient were employed respectively.

Table 4.1: Reliability Statistics

Spearman-Brown Coefficient	Equal Length	.964
	Unequal Length	.965
Guttman Split-Half Coefficient		.951
a. The items are: LTK, GIV.		
b. The items are: GPD, STP, SDG.		

The reliability statistical outcome revealed that Spearman-Brown unequal length was 0.965 (96.40%) and Guttman Split-Half Coefficient (0.951).

From the above, the response variables and moderating variable resultant outcomes, calls for authenticity and certification by confirmatory factor analysis, because it reveals the sphericity and adequacy of the samples by adopting the Barlett test and Kaiser-Meyer-Olkin (KMO) by using the principal component analysis.

Table 4.2: Confirmatory Factor analysis test using the Barlett Test and KMO

	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
LTK	.358	.323	1.000	.903
GIV	.366	.297	1.000	.813
GPD	.345	.335	1.000	.972
SDG	.345	.335	1.000	.972

Extraction Method: Principal Component Analysis.

Communalities

The communalities model was integrated to show the level sphericity and sample adequacy using KMO and Barlett test.

Since, the rescaled value of KMO and Barlett test exceed 0.6 (60%) it could be seen as consistence and authentic because of the threshold demonstrated by the explanatory variable, response variables and moderating variable.

Statistical Analytical Test

The statistical analysis considered the univariate, bivariate and multivariate analysis. From the total 175 copies of questionnaire administered, only 162 were justified from processing, coding and data cleaning. The regression analysis was employed to analyze the three hypotheses whereas, the Partial Correlation Co-efficient was used to analyze the moderating variable.

Univariate Analysis

The univariate analysis was used to determine the descriptive statistics.

Table 4.3: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
LTK	162	3.00	5.00	4.6000	.59824	.358	-1.245	.512	.783	.992
GIV	162	3.00	5.00	4.5500	.60481	.366	-1.003	.512	.189	.992
GPD	162	3.00	5.00	4.6500	.58714	.345	-1.521	.512	1.636	.992
SDG	162	3.00	5.00	4.6500	.58714	.345	-1.521	.512	1.636	.992
Valid N (list wise)	162									

Based on the above table, from the mean statistic it can be easily identified that the highest values are GPD and SDG (green product and sustainable development goals respectively). This posits that they have credible advantage especially because they also have low standard deviation. Hence, lean thinking and green innovation poses more riskiness and volatility is its policy and decision making. Thus, the thinking and innovation process should be streamline and compose to suit the purpose in the long-term and short-term to avoid sub-optimality and dysfunctionality in the systems. As a rule of thumb, a skewness should be between -1 and -0.5 or 0.5 and 1. Any skewness less than -1

or greater than 1 shows that the distribution is highly skewed. The average responses associated to these variables must most likely be evenly distributed over the five-point Likert scale. While for other explanatory variable, response variables and moderating variables, their respective actions could most likely be “highly” skewed negatively. Similarly, a skewness close to zero shows a non-normally distributed data which is not the case with our study variables.

The kurtosis which shows the sharpness and height of the central peak is meant to be with the range of -2 and 2 and in some cases -3 and 3. It can be seen that majority of the

variables fall between these bracket and are therefore seen as normally distributed.

*Bivariate Analysis*

The bivariate analysis beneath is focused on the analytical framework that demonstrates the explanatory and response variables. Since the Adjusted R Square possesses the features of analysis the variables in the model with collinearity diagnostic and statistics test, the outcome was best fit in analyzing the hypotheses. Also, the Eigenvalue, VIF, Tolerance (reciprocal) and Condition index were utilized to confirm the plight of variance collinearity in the study based

on increase or decrease of absolute limit of approaching infinity. Where  $R^2_{adj}$  represent the Adjusted R Square value, whereas  $\lambda$  represent the Eigenvalue and VIF represent the variance inflated factor. The entire test in the model displayed were based on significance value of 0.00 which is less than the 5% (0.05) significance level ( $p = 0.00 < 0.05$ ) that leads to the acceptance of the alternative hypotheses.

*Hypothesis 1*

**H<sub>01</sub>:** Lean thinking does not significantly correlate green innovation

4.4a: Model Summary <sup>b</sup>											
Model	R	R Square	Adjusted R Square	Change Statistics					Durbin-Watson		
				R Square Change	F Change	df 1	df2	Sig. F Change			
1	.929 <sup>a</sup>	.863	.855	.863	113.430	1	160	.000	2.530		
a. Predictors: (Constant), LTK											
Dependent Variable: GIV											
4.4.b: Coefficients <sup>a</sup>											
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(C)	.456	.397		1.148	.266					
	LTK	.912	.086	.929	10.650	.000	.929	.929	.929	1.000	1.000
Dependent Variable: GIV											
4.4.c: Collinearity Diagnostics <sup>a</sup>											
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	LTK						
1	1	1.992	1.000	.00	.00						
	2	.008	15.841	1.00	1.00						
a. Dependent Variable: GIV											

The model illustrates Adjusted R-square value of 0.855 (85.50%) correlates with LTK (Lean thinking) on very strong positive correlates revealed on GIV (Green innovation). The F-statistics of 113.430 values at 0.000 alpha level of significance and the Durbin-Watson 2.530 value within the range of 1.5. to 2.5 means that the model is best fit at optimum. The resultant impact demonstrates that, unit increase in Lean thinking (LTK) stimulates to 0.912-unit enhancement in green innovation. In the nut shell, regression outcome of Partial Correlation/standardized coefficient beta of .929 (92.9%) with the value of t-statistics of 10.650 (which is greater than the  $\pm 1.96$  threshold level) revealed a very strong positive significance capture in the variables. Nevertheless, from the collinearity diagnostics the eigenvalue of 1.992 and condition index of 15.841 that trace with tolerance of the collinearity statistics of 1 among the proxies, shows the

significance presence of very minute collinearity that seen to be worrisome, but does not affect the correlation. Since, the VIF is 1, It lacks the capacity because of the partial correlation and adjusted R-square index. The model demonstrates that there is significant correlation between lean thinking and green innovation, meaning the null hypothesis is rejected and the directional hypothesis rejected. This further revealed that lean thinking have the bona fide capacity to influence green innovation. Hence, firms in Africa and globally wise should adopt lean thinking to foster the growth on innovativeness (product, process, market and technology). This is while Herbert Einstein argues that imagination is better than mere knowledge because, the ability to thinking goes in line with invention, creativity and brainstorming. Similarly, Ries (2011) frankly boosted that for entrepreneurs to survive and sustain radical enterprise function, they must apply the



lean thinking principles to capture the business. Geoffrey (2017) opined that for green entrepreneurs to survive in the long-run in profits, innovation should be green in all ramifications on the organization, society and environment. Osman, Mamat and Ali (2020) strongly believed that lean transformational innovation models is a good vibes for firm to augments green, because O’Neill and Gibbs (2016) sees rethinking green entrepreneurship is the potential means of lubricating any nations economic growth and development strategically. Also, Gibbs and O’Neill (2014) support the lean

continuous rethinking for green entrepreneurship as measure to rebuild green innovation on people, profit and planet. For actualization of lean thinking and green innovation and green product, de Bruin (2016) suggested that an analytical framework should be design and structure by green entrepreneurs in line with lean principles.

*Hypothesis 2*

**Ho<sub>2</sub>:** Lean Thinking does not significantly correlate green product

4.5a: Model Summary <sup>b</sup>											
Model	R	R Square	Adjusted R Square	Change Statistics					Durbin-Watson		
				R Square Change	F Change	df1	df2	Sig. F Change			
1	.796 <sup>a</sup>	.633	.613	.633	31.105	1	160	.000	1.572		
a. Predictors: (Constant), LTK											
b. Dependent Variable: GPD											
4.5b: Coefficients <sup>a</sup>											
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(C)	-.262	.867		-.302	.766					
	LTK	1.024	.184	.796	5.577	.000	.796	.796	.796	1.000	1.000
4.5c: Collinearity Diagnostics <sup>a</sup>											
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions							
				(Constant)	LTK						
1	1	1.995	1.000	.00	.00						
	2	.005	20.561	1.00	1.00						
a. Dependent Variable: GPD											

The model above illustrated that adjusted R-square value of 0.613 (61.30) is strong correlates between lean thinking (LTK) and Green product (GPD). This demonstrates that lean thinking obtains the capability to influence green product. This 0.387 (38.70%) represent the variation not captured in the model. The F-statistics of 31.105 value at 0.000 level of significance and Durbin-Watson 1.572 value demonstrate authenticity of the model fitness in the analysis.

The GPD (Green product) experience every unit increase from the intervention of lean thinking (LTK) that leads to 1.024-unit. This revealed that the correlation between the explanatory variable and response variable in the long run and short run. The Partial Correlation/standardized coefficient beta of .796 (79.60%) with the t-statistics value of 5.577 (which is greater than the ±1.96 threshold level) and a probability level of 0.000 which is less than the 0.05 significance level that aligned with tolerance of the collinearity statistics of 1 among the proxies. In all, from the collinearity diagnostics the Eigenvalue of 1.995 and condition Index of 20.561 that there is significance presence of collinearity among the Lean thinking and Green product that is worrisome and call for concern because the correlation impact is far highly than the

threshold, which demonstrates the rejection of the null hypothesis. This is because certain occurrences in the long run and short run can dramatize to impact on long term or short term orchestration. This is in line with Thangarajoo (2015) argument that lean thinking is a way forward toward focusing on customer satisfaction, just as Delafrooz and Moghaddam (2017) research on using Iran map as model to address green products on consumers’ segmentation basis towards environment sustainability. Chibuike *et al.*, (2022) discussed in details on how lean could be synchronized toward achieving green product and innovation sustainability in the environment by entrepreneurs. Nieuwenhuis (2018) settled on how to avert green product effect in the globe by beckoning on entrepreneurs to utilization non-polluted product with high carbon and dangerous substances that will be detriment to the society and environment. This is while Affolderbach and Krueger (2017) call for entrepreneurs to develop continuity in rethinking on product, process and technology innovation with conceptualized framework on the betterment of the enterprise and society. However, just as lean thinking focus on the customer, Ahmad, Mahmood, Ariza-Montes and Han

(2021) pointed out that sustainable product and innovation should be focused on the customer heart and satisfaction.

### Hypothesis 3

**H<sub>03</sub>:** Sustainable development goals do not significantly moderate the correlates between lean entrepreneurship and green entrepreneurship.

Table 4.6: Partial Correlation test for analyzing the moderating role SDG correlates between lean entrepreneurship and green entrepreneurship.

Correlations				
Control Variables			Lean entrepreneurship	green entrepreneurship
Sustainable Development Goals	Lean entrepreneurship	Correlation	1.000	.772
		Significance (2-tailed)	.	.000
		Df	0	162
	Green entrepreneurship	Correlation	.772	1.000
		Significance (2-tailed)	.000	.
		Df	162	0

From the alpha level of significance capture in the model as 0.000, shows the moderating role of the sustainable development goals has 77.20% correlates on among lean thinking (lean entrepreneurship and green innovation/green product (green entrepreneurship). The non capture 0.228 (22.80%) revealed the neglect and weakness of green entrepreneurship and lean entrepreneurship negligence from the environmental issues or corporate issues. It pointed out that there need an urgent sensitization of the SDG among Africans to queue in alignment of the benefit for industrial transformation, research, innovation and development on the academic curriculum that would eradicate poverty and pursuit of zero degree hunger using the lean and green approach. To support the discussion, Ovharhe (2022) mentioned that sustainable development goals has already develop an automatic platform to accommodate the correlates of lean entrepreneurs and green entrepreneurs easy to accomplished the vision and mission of enterprise. Hence, Thangarajoo (2015) postulates that entrepreneurs need to take advantage of the sustainable development goals platform by continuous rethinking because that what lean and green entrepreneurs are created for. Vuorio, Puumalainen and Fellnhofer (2018) that advances of this, by saying that drivers of entrepreneurial intentions in sustainable entrepreneurship settled the matter (Chibuiké *et al*, 2022). But, Sze (2018) went further, that this can be done through entrepreneurial mindset of innovativeness.

## V. CONCLUSION, RECOMMENDATIONS AND CONTRIBUTION TO SCHOLARSHIP

### 5.1. Conclusion

The study investigates the correlate between green entrepreneurship and lean entrepreneurship. The explanatory variables from the result seem to correlate with the response

variable. But, the Eigen value (close to zero) and condition index (greater than ten) almost exhibit unreasonable minute level of collinearity presence which might be worrisome because on the noise. However, it does not affect the high level of correlation among the predictor, criteria and moderating variable because the VIF is already in perfect condition of one. In conclusion, there exist positive correlation among leaning thinking influence on green product and green innovation.

### 5.2. Recommendations

1. Lean entrepreneurs should develop and design an analytical framework to synchronized lean thinking principles with green product and green innovation.
2. Entrepreneurs should always facilitate continuous improvement on devising green innovation towards the sustainability, survival and success.
3. Lean entrepreneurship and green entrepreneurship aims should focus on customer care, safety and satisfaction.

### 5.3. Contribution to Scholarship

In line with the study, the contributions identified are as follows.

- The sample size and model adopted in the study is very vital to the knowledge gap. Hence, the bottom line of the triple Ps is either it is green or greed.
- The 3Ps people profit and planet are simultaneous with sustainability, survival and success.
- Lean thinking is a python to product innovation and green product.

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APPENDIX A  
QUESTIONNAIRE

Please Tick [ ] in the appropriate place

PERSONAL DATA

1. Name of Enterprise .....
  
2. Gender:
  - a. Male [ ]
  - b. Female [ ]
  
3. Marital Status:
  - a. Single [ ]
  - b. Married [ ]
  
4. Age:
  - a. 20 – 29 [ ]
  - b. 30 – 39 [ ]
  - c. 40 – 49 [ ]
  - d. 50 – 59 [ ]
  - e. 60 and above [ ]
  
5. Educational qualification:
  - a. Primary [ ]
  - b. Secondary [ ]
  - c. Tertiary [ ]
  - d. Non Literate [ ]
  
6. Number of years in the practice:
  - a. less than 2 years [ ]
  - b. 2 – 5 years [ ]
  - c. 6 – 10 years [ ]
  - d. above 10 years [ ]
  
7. Length of experience:.....

Please carefully tick (√) the option as it relates to your likelihood perception of the questions.

1 = **Very dissatisfied**

2 = **Dissatisfied**

3 = **Neither satisfied nor dissatisfied**

4 = **Satisfied**

5 = **Very satisfied**

*Lean Entrepreneurship*

S/N	PART A: Lean Thinking	1	2	3	4	5
1.	Our focus is on client service delivery					
2.	Our thinking faculty is fashioned on designing quality product and service delivery for our customer					
3.	Our continuous improvement is quality, timely, low cost and speed					
4.	Customer satisfaction is all we think about					
5.	Our desire is on pull system towards our reputation					

*Green Entrepreneurship*

S/N	PART B: Green Product	1	2	3	4	5
1.	Our product is standardized by consumer advocate and statutory regulatory bodies					
2.	Our concern for our client is specification based on green policy					
3.	Our devotion to green policy is total					
4.	We coordinate safety, recycle, disposal and control our waste					
5.	Our consciousness on green affect labeling, designing, coloring and packaging					
S/N	PART C: Green Innovation	1	2	3	4	5
1.	Our green policy guides our innovative consciousness					
2.	Our green framework monitors and cross-inspect production process					
3.	We invent natural and organic product to safe live and the planet					
4.	Our administrative, market and technology innovation are orchestrated by green culture					
5.	We innovate ergonomic activities in work environment					

*Moderating Variable*

	PART D: Social Development Goals					
1	Good health and wellbeing are deterministic factor for livelihood					
2	Poverty are the iota of depression, frustration and anxiety					
3	Hunger is rapidly increasing as threat to human existence and life expectancy					
4	Education is the bedrock of knowledge, information and meaningful sustainable development					
5	Industrial innovation and infrastructure are pivotal strength of human development and scientific discovery					