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A multivariate analysis of an enterprise development strategy for the development of functional foods derived from African indigenous plants

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Abstract

An enterprise development strategy linking science with business applications moderates effective development and commercialisation of a functional food production plant. However, as most theories agitate a largely scientifically skewed process, poor interplay between science and business applications often undermines effective development and commercialisation of functional foods derived from a variety of indigenous African plants.

This research seeks to address this gap by using multivariate analysis to evaluate the null hypothesis that a scientific process intricately intertwined with critical business processes for the development of a functional food production plant catalyses its successful establishment, growth, sustainability and profitability. Using statistical data drawn from 40 firms in the food and beverage industry, results of multivariate analysis revealed that irrespective of the attractiveness of the scientific values of the new functional food concept, a scientific process intricately intertwined with critical business processes is still often critical for leveraging the initial marketing and promotion of new functional food concepts as well as the adoption of the appropriate manufacturing strategy.

As the adoption of an appropriate manufacturing strategy enhances cost minimisation and resource optimisation, all these combined with the moderating effects of the improved linkages between the functional food production plant with suppliers and distributors were found to catalyse the overall competitiveness and sustainability of the new functional food concept, even in the midst of the increasing proliferation of the often equally competitive new rival functional food concepts.

Basing on these findings, the study concludes with an enterprise development strategy that businesses can replicate to aid linking and intertwining scientific research with the process for the development of functional food production plants.

Key phrases

Enterprise development model; functional food production plant; indigenous African plants; linking scientific process to business development; sustainability

1. INTRODUCTION

The notion of functional foods is a health science concept agitating for the integration of food with medicine and medicine with food (Chen 2011:253). Its development often undertakes a largely scientific process entailing identification of health challenges, and plants or animal products from which functional foods are extracted, tested, experimented and developed to respond to such health paradoxes (DStuff 2015:5). However, a disconnect between this largely scientific process and the enterprise development process encompassing ideation, conceptualisation, production and commercialisation often affects the business rationale for the development and establishment of most functional food production plants. It causes over application of science and correspondingly limited business analytics that in turn undermines the successful establishment of most functional food production plants that could have been successfully established.

A largely scientifically skewed process of functional food development affects effective understanding of the unfolding industry trends and a combination of marketing strategies that can be undertaken. This is attributable to the fact that in most of the cases, functional food concepts are developed on the assumption that as long as the concept is scientifically sound, it will attract the desired market performance (Van Tienen, Hullegie, Hummelen, Hemsworth, Changalucha & Reid 2011:198).

Unfortunately, as increasing opportunities in the functional foods markets continue to lure more and more new rivals to engage in equally competitive different versions of functional food concepts, functional food markets are often rendered more competitive and unpredictable for only the scientific attractiveness of the concept to spur its business viability. To develop a scientifically vibrant concept as well as a more lucrative and successful business concept from the scientifically developed functional food concepts, the use of an appropriate enterprise development strategy linking science with critical strategic business applications is certainly a prerequisite.

Utilisation of an appropriate enterprise development strategy minimises risks of poor understanding and response to the unfolding industry trends. It also minimises risks of conceiving and applying poor marketing and manufacturing strategies that may in turn also affect the concept's price competitiveness. Inversely, if well undertaken, an enterprise development strategy linking science with critical strategic business applications may improve the refinement of the functional food concept's business aspect, as the scientific process does the improvement of its scientific and health concepts.

All these may leverage effective management of the complexities often associated with the concept's conceptualisation, manufacturing, market introduction, marketing and managing growth in the midst of emerging new competition (Carrillo, Fiszman, Prado-Gasco & Varela 2013:361; Schutza, Spinksa & Urala 2011:407). In the end, all these moderate not only the overall effectiveness of the process for the development and commercialisation of a functional food production plant, but also the extent to which the developers of a functional food concept are also able to achieve its desired business and scientific outcomes (Schutza *et al.* 2011:407).

Unfortunately, as most theories agitate for a largely scientifically skewed process for functional food development, poor interplay between science and business applications seems to continue to undermine effective development and commercialisation of functional foods derived from a variety of indigenous African plants (Mpofu, Linnemann, Sybesma, Kort, Nout & Smid 2014:2591; Van Tienen *et al.* 2011:198).

Indigenous African plants are wild or home grown vegetations and plants mainly found in Africa that are processed and consumed by the local African population not necessarily for their functional values, but for basic nutritional requirements and needs (Mpofu *et al.* 2014:2591). To address paradoxes arising from the poor interplay between science and business applications to mar the development and establishment of more commercially vibrant functional food production plants, this research uses a multivariate analysis to explore, test and develop an enterprise development strategy intertwining science with business applications that businesses can replicate to improve the successful development and commercialisation of functional foods developed from a variety of the indigenous African plants.

2. LITERATURE REVIEW

Functional foods are health fortified, enriched or enhanced foods which if consumed on a regular basis provides the market or the consumers with enormous health benefits that far exceed the mere provision of essential nutrients such as vitamins and minerals (Rameshwar, Kramadhati, Judith & Nguyen 2011:222). Such health benefits and advantages are often associated with the reduction of the risks of contracting chronic diseases such as heart disease, cancer, osteoporosis, diabetes and strokes. Functional foods are often derived from animals or plant products such as garlic and spinach. Although the values of functional foods are increasingly recognised by most of the contemporary consumers, the essence of intertwining food with medicine and medicine with food is however not a recent concept. It was first coined as one of the central tenets of medicine 2500 years (Maanda & Bhat 2010:179; Majova 2011:4; Mavengahama, McLachlan & de Clercq 2013:29). In this central tenet, Hippocrates, the father of the contemporary medicine stated “Let food be thy medicine and medicine be thy food.”

However, in the wake of the advent of the concept of drug therapy in the early 19th century, the concept of functional food was however, abandoned only to be re-awakened in the late 19th century as researchers sought to explore the important role of diet in disease prevention (Granato, Branco, Adriano & Faria 2010:292).

Despite precipitating significant proliferation of nutritious foods, its negative implications soon emerged in the diseases linked to excessive nutrition in the 1970s that prompted aggressive campaigns to encourage the use of diets low in saturated fats, vegetables, fruits, grains and legumes to reduce risks of chronic diseases such as heart disease, cancer, osteoporosis, diabetes and strokes (Watuleke 2010:6). It is these campaigns that spurred a paradigm shift from the traditional needs of nutrients and vitamins in favour of the emergence of a new self-care paradigm. In new self-care paradigm, customers are increasingly seeking to take care of their own health by consuming only foods that enhance their health or prevent the contraction of cancer, osteoporosis, diabetes and strokes (Gruber 2015:10; Ngobi 2009:82).

These campaigns were followed by rigorous scientific research to identify physiologically active components such as phytochemicals and zoochemicals in foods from both plants and animals to potentially reduce risk of chronic diseases (Carrillo *et al.* 2013:361). All these spurred the demand and research for functional and health foods among the population and scientists to thereby lead to what is today known as "functional foods", meaning, food with significant positive health implications that far exceed the mere basic diet and nutrients (Carrillo *et al.* 2013:361).

2.1 Scientific research and development of functional foods

The argument that the process for the development of functional foods is often scientifically skewed is implicitly evident in most scientific theories reiterating the scientific conceptualisation and development of functional foods from plants or animals to entail identification of new health challenges, analysis and identification of functional plants or animals, extraction of functional ingredients, testing, experimentation, development and marketing of the developed functional food concept (Bharucha & Jules 2010:291; Ozen, Pons & Tur 2012:472; York, De Wet & Van Vuuren 2011:696). Depending on the identified new health challenges, analysis and identification of functional foods require evaluation of plants or animals that provide functional benefits fortified with vitamins and minerals like vitamin C, vitamin E, folic accede, zinc, iron and calcium. It also aids identification of functional foods fortified with micronutrients like omega-3 fatty acid, phystosterol and soluble fibre to promote good health or prevent diseases such as cancer, stroke, heart failure and hypertension (Brain & Muyonga 2014:427; Hasler 1998:57 as cited in Brain & Muyonga 2014:427.)

In that process, the analysis and identification of functional foods that improve regular stomach and colon functions in humans, or reduce high cholesterol and high blood pressure are often accompanied by the evaluation and identification of functional foods with probiotics or prebiotics (Granato *et al.* 2010:292; Ozen *et al.* 2012:472; York *et al.* 2011:696). Probiotics are live microorganisms that confer enormous health benefits when consumed in larger amount. Probiotics are found in dairy products, synbiofir, synbioghurt, yoghurt, huntcult, fermented drink, milli premium sour cream, and Aktivit quark dessert (Ozen *et al.* 2012:472). In contrast, prebiotics are non-digestible food ingredients that stimulate growth of bacteria in the colon to thereby improve humans' overall health conditions (Olum, Okello-Uma, Tumuhimbise, Taylor & Ongeng 2010:18; Rutebemberwa, Lubega, Katureebe, Oundo, Kiweewa & Mukanga 2014:18).

Quite often, analysis and identification of plants or animals from which functional foods can be extracted is followed by experimentation and testing to extract microorganisms that can be used to treat health related conditions such as cancer, intestinal tract function, immune function, allergy, stomach health, urogenital health, cholesterol lowering and hypertension (Ozen *et al.* 2012:472). In a normal scientific process, such a process of testing and experimentation of the extracted functional ingredients from animals or plants leads to the development and marketing of the developed functional food concept. However, Roberfroid's (2000;1660) concepts and strategy for functional food science heralds the process for developing functional food products is often accomplished according to two critical steps.

As cited in Apenten (2010:3), the two critical steps highlighted in Roberfroid's (2000;1660) concepts and strategy for functional food science encompass the analysis of the overall perceptions of the consumers and the general community about the positive health implications associated with the consumption of certain products, and analysis of new generation of hypothesis driven human studies to reach scientific conclusions on whether or not such a product is functional.

- ***Analysis of the overall perceptions of the consumers and the general community about the positive health implications associated with the consumption of certain products***

The analysis of the overall perceptions of the consumers and the general community about the positive health implications associated with the consumption of certain products is often accompanied by the evaluation of the implication of functional foods on the reduction of the risk of pathological processes. This facilitates the determining of whether the consumption of such food induces the claimed reduction of the risk of the disease. To reach such logical conclusions, studies are usually conducted to identify animal or plant products used informally by the communities to reduce or cure different health conditions.

After the isolation of such plants or animal products, further analysis is undertaken to explore and understand the opinions of the general potential customers about the health implications of such plants or animals. This is often followed by scientific ideation and conceptualisation of how the concept can be improved to offer the required enormous health benefits. It is at that point that Roberfroid (2000:1660) emphasises that the first prototype to be generated must be subjected to thorough scientific testing, modelling and re-modelling to test the hypothesis about the positive health implications that it claims to induce.

- ***Analysis of new generation of hypothesis driven human studies to reach scientific conclusions on whether or not such a product is functional***

To eliminate all doubt, it is the fundamental argument in Roberfroid's (2000:1660) concepts and strategy for functional food science that it is still critical that new generation of hypothesis driven human studies is undertaken to reach scientific conclusions on whether or not such a product is functional. The conclusion that a product is functional leads to the second set of activities involving modulation of relevant target functions. This process is often divided into two paths.

The first path deals with the evaluation of the metabolic and physiological functions of the food to assess whether the consumption or the use of the food leads to the claimed enhanced functions (Apenten 2010:3).

The second path is undertaken to evaluate the implication of functional foods on the reduction of the risk of pathological processes so as to determine whether or not the consumption of such food induces the claimed health benefits. Roberfroid's (2000:1660) framework also emphasises the need for government interventions through appropriate policies and fiscal support to direct the research and production of functional foods. As much as Roberfroid's (2000:1660) concepts and strategy of functional food science seems effective for developing and validating functional food concepts, it also seems to be largely skewed to the use of science as contrasted with the facilitation of the interplay between science and business applications in the development of functional foods.

2.2 Enterprise development

Enterprise development is a strategic process of ideation and conceptualising critical structures and operational processes and systems that must be developed and put in place in the context of the available resources to ensure that a business achieves all its critical business outcomes (Cooper & Edgett 2012:5). Since most enterprises emerge from new products or business concepts, it is implicitly evident from theories that the process of the development and establishment of food processing plants often undergo five main stages encompassing ideation, conceptualisation, development, establishment and growth (Cooper & Edgett 2012:5; Kind & Knyphausen-Aufseb 2007:176; Maurer 2016:3).

- ***Ideation***

Ideation is a strategic process of imagining and generating information critical for thinking and rethinking of what the product ought to be (Priem & Carr 2012:346). It entails analysis and thinking of the likely core features and attributes to be integrated to define the product vis-à-vis the imagination of how such a product would effectively respond to the prevailing market and industry trends (Maurer 2016:3). Ideation is a cognitive process facilitating the formulation of the vision of what the core contents of the product would constitute. It also enhances the often critical initial feasibility assessment of whether if the product is subsequently developed; it can turn into a viable business concept (Houterman, Blok & Omta 2014:6). It is in that process that it is critical the scientific process of a product development is integrated with relevant business analysis to discern whether the product to be developed will perfectly respond to the most pressing needs and demands of the market (Troxle & Linton 2014:6).

Ideation influences the information gained and used in the conceptualisation stage. It is a critical stage defining the future success or failure of the product that may not only involve forecasting of the potential future attractiveness of the market, but also the cost and requirements of compliance with relevant industry regulations. In the South African context, such analysis would also require evaluation and analysis of the cost and requirements of compliance with relevant regulations such as the guidelines of the Health Professions Council of South Africa (HPCSA 2008:9).

Using the general ethical guidelines for biotechnology research, HPCSA (2008:9) requires adherence to the principles of fairness, competence, objectivity, responsibility, integrity and sensitivity in biotechnology research and studies. These principles require research involving animals, humans and plants to undertake necessary precautionary measures to identify and avoid risks of harm or damage that may affect animals, humans and plants being used as subjects in such a study.

Compliance with such provisions often requires early evaluation so as to determine the proactive intervention measures that can be undertaken. To enhance the generation of enormous ideas and selection of the best, ideation may require the application of a combination of techniques encompassing voice-of-customer methods, open innovation approach, peripheral vision, disruptive technologies, patent mapping and internal ideal capturing (Cooper & Edgett 2012:5). To edify the ideation process' effective response to the unfolding customer needs and demands, voice-of-customer methods use ethnographical research, customer visit teams, customer focus group discussions, lead user analysis, user designs' analysis and customer brainstorming (Cooper & Edgett 2012:5). The application of these methods enhances understanding and identification of the processes that customers undergo in the use and application of different products. This enables identification of gaps or areas that can be modified if the product to be developed is to create points-of-difference setting it apart to leverage its overall competitiveness (Hellstrom 2014:154).

However, voice-of-customer methods may tend to be less effective, unless undertaken in conjunction with open innovation approaches to link and improve information exchange and sharing between the ideator, partners and vendors, as well as the external technical communities and businesses (Cooper & Edgett 2012:5). Besides gaining from the evaluation of the idea's external contest and its competitiveness, it also aids the evaluation of how the product's imaginary design compares superiorly with the other emerging ideas. It is through this analysis that product developers are able to proactively diagnose and discern the overall attractiveness of their ideas and the extent to which it is able to emerge as a sustainably vibrant future business concept (Priem & Carr 2012:346). Although such methodologies drive decisions on the selection of the best ideas, uncertainties also often arise from the abstract knowledge about the market, technology, suppliers, competition, internal organisation, resources, standards and regulations. Ambiguities arising from the emergence of non-routinal tasks and high dependence on product champions may also cause work overload slowing the translation of the idea into the actual product concept (Priem & Carr 2012:346).

- ***Conceptualisation***

It is during conceptualisation that the imaginative aspects of the product are developed and translated into prototypes for further refinement (Fielt 2013:85). Conceptualisation aids discerning whether if subsequently developed, the product would perfectly match the prevailing market and industry needs and expectations. Conceptualisation is often not only a laboratory based activity. Instead, it is also a consultative process requiring involvement and information exchange with relevant customers and sample customers drawn from the market to be targeted by the final product (Dubiel & Ernst 2012:100). In terms of the scientific process of developing a product, the conceptualisation process may also require analysis and evaluation of legislations and regulations governing such a product's development and usage. It entails imagination of what the product ought to be. Conceptualisation also encompasses analysis and sensing of the probable risks that may emerge as well as its potential to effectively serve the target market in the way that leverages recouping of significant percentages of the costs to be incurred in such a product's development (Dubiel & Ernst 2012:100).

Conceptualisation often undergoes through three main phases encompassing internal conceptualisation, representational conceptualisation and social conceptualisation (Fielt 2013:85). Internal conceptualisation entails the selection of the best idea generated during the ideation process. Such idea is subjected to further visual imaginations and refinements that lead to further conceptualisation and re-conceptualisation to extract the best concept. Through representational conceptualisation, the selected final concept is often further visually represented on paper or using computer generated systems (Teece 2010:172).

Representational conceptualisation offers a pictorial representation of the concept not only to discern the concept's likely components and ingredients, but also how it will relate to the other products. It also enhances analysis and development of the critical formulas, processes, methods, systems and resources that will be required for the development of such a product (Dubiel & Ernst 2012:100). Such analysis is often further edified by social conceptualisation in which the concept is forwarded to peers and experts for critics and further analysis and suggestions for further improvements. It is through such pear and expert evaluations of the concept, that further analysis is undertaken to extract the final concept that can be developed into a final product (Zott & Amit 2013:403). With the concept refined in the conceptualisation stage, the final version of the specification of the product and its formulas are often applied in the development stage to develop and produce the final product (Salhieh & Mira 2014:44).

- ***Development***

Development is the process of translating the concept into a tangible product (Zott & Amit 2013:403). It also involves analysis and evaluation of how the product can be cost-effectively engineered at the costs that are relatively profitable. Such analysis is often accomplished using conjoint analysis and value engineering. Conjoint analysis aids the identification and enrichment of product attributes and features considered by customers to add values and the business as the most profitable features and attributes. It enables the identification of the relative importance of each feature on the overall perceived utility of the product as well as its contribution to the product's utility at each level of the process of a product's development. To gain insight into product features as perceived in terms of relative importance to customers, conjoint analysis often utilises a combination of methodologies encompassing full-profile stimuli, partial-profile, adaptive and choice-based conjoint analysis (Thomas & Chandrasekaran 2013:10).

Full-profile stimuli conjoint analysis offers customers with an array of features and attributes associated with a particular product against which the sample customers are requested to rank order all the stimuli and a metric rating of each stimulus. In this process, only the features with higher rankings are selected and integrated into the final product. Full-profile conjoint analysis may be undertaken in conjunction with partial-profile conjoint analysis to evaluate some of the explicit and assumed product features (Thomas & Chandrasekaran 2013:10). Drawing from the results of such analysis, only features with higher rank orders and ratings are selected and integrated in the product during the development process.

However, decisions made after such analysis are often further improved after adaptive conjoint analysis in which based on the intermediate values of the estimates of the features, new features with rich information contents are selected (Kuzmanovic & Obradovic 2010:51). As choice-based conjoint analysis explores customers' perceptions about the uncertain product features significantly decreasing in values. Such analysis clarifies uncertainties that product developers often face to improve the overall attractiveness of the product to be developed. In contrast to conjoint analysis that focuses on gathering enormous customer perception about the product so as to determine the modifications that can be undertaken prior to the product's manufacturing, value engineering often seeks to integrate customer perceptions with a firm's views in the design and manufacturing of a product (Kuzmanovic & Obradovic 2010:51).

It is the fundamental argument of value engineering that a product's values are best viewed and understood according to customer perspectives and the firm's understanding of the nature of the product. From the customer's point of view, a product comprises features and benefits arising from its consumption, as for the firm, a product constitutes of a bundle of integrated parts and processes that influence its production and manufacturing (Salhieh & Mira 2014:44). To strike a trade-off and balance these benefits, value engineering emphasises that critical benefits and functions most cherished by customers must be integrated in the manufacturing process, but at a cost less than the summation of all the benefits that the product offers to customers (Salhieh & Mira 2014:44).

As value engineering and conjoint analysis enhance the analysis and gathering of relevant information, web-based technologies such as design for manufacturing and assembly (DFMA) tend to enhance the integration of the identified critical customer demands and needs in the design and development of prototypes (Zott & Amit 2013:403).

However, the initial stages of a product's development may still require further testing and re-testing as well as scientific and market experimentations. This aids the improvement of the product's features, design and attributes to subsequently edify its overall marketability (Zott & Amit 2013:403). Improved confidence and trust of the enterprise about its product often spurs decisions to develop and establish the actual production plant to improve the manufacturing and the commercialisation of such new innovations (Zott & Amit 2013:403).

- ***Establishment***

Establishment refers to the process of developing and commencing actual operation of the plant to manufacture the now well confirmed and understood product concept (Priem & Carr 2012:346). A production plant's establishment decision is often influenced by a combination of location factors explaining proximity to the market as well as proximity to the sources of inputs (Sorensen 2012:20). To ensure an enterprise minimises costs of transportation, it is often critical to ensure the production plant is established in locations more proximate to the sources of inputs. Such decisions are also often undertaken in conjunction with the evaluation of the nature of the inputs as well as risks of perishability of such inputs (Sorensen 2012:20). In the evaluation of the location decisions, proximity to the market can usually be leveraged by developing efficient distribution networks and partnerships with wholesalers and retailers to improve the lead time and flow of finished products from points of manufacture to the points of sale (Giannoulis, Bergholtz, Zdravkovic, Stirna & Johannesson 2014:5).

Quite often, the process for the development of a manufacturing plant is accomplished in aid of a combination of different enterprise modelling strategies (Giannoulis *et al.* 2014:5). Enterprise modelling is a strategic organisational analysis mechanism that configures relationships that may emerge from the flow of activities to create a system that synchronises and coherently links with all the internal processes, methods and systems. It also facilitates external links with the critical partner businesses such as distributors, customers, suppliers and logistic service handlers (Herve & Cecil 2013:27).

Enterprise modelling creates and synchronises different structures, inter-relationships, dependencies and architecture of the organisation to edify the overall effectiveness of an enterprise's inter-operability. It offers the foundation for understanding of the overall nature of an organisation's operation for further improvements to be undertaken to enhance the overall manufacturing efficiency (Teece 2010:172). Enterprise modelling may entail the application of enterprise knowledge development approach, requirements' engineering approach, value modelling approach and business modelling ontology approach (Lann 2013:61).

Enterprise knowledge development approach offers a holistic analysis and development of the key structures, processes and systems of an enterprise. To undertake such holistic analysis, enterprise knowledge development model utilises an integrated framework consisting of six other sub-models encompassing goal model reflecting an enterprise's vision, goals and strategies, business rules model outlining critical rules and regulations, and business concepts reiterating key business approaches and culture that must be espoused to enhance achievement of the desired goals and objectives (Lann 2013:61).

In addition to business process model espousing critical operational processes, methods and systems, enterprise knowledge development model also often constitutes of actors and resource models reflecting relevant critical structures and technical components and requirement model offering the required technological platforms for an enterprise's operation (Jardim-Gonçalves & Grilo 2013:7). Requirements' engineering focuses on creating a platform linking all the actors and stakeholders such as customers, suppliers and distributors. Value modelling approach creates systems for developing and enriching enormous benefits and values for customers as well as the firm (Fitkov 2010:3). Business modelling ontology strives to develop and shape an enterprise which is effectively responsive to customer demands and needs. It is the decisions and activities accomplished in these stages that spur growth of the manufacturing plant to pass the introduction and growth stages.

- ***Growth***

Growth refers to the successes that a manufacturing plant achieves to spur increment of sales, revenues and profitability that in turn leverages the overall returns on shareholders' values (Lorenzi & Sorensen 2014:3). Improved levels of shareholders' value catalyses increment of enormous financial resources for investments in further organic or inorganic growth. Increment of profitability resulting from a manufacturing plant's growth may also reduce the overall level of an enterprise's gearing that often have significant bearing on an enterprise's future sustainability (Lorenzi & Sorensen 2014:3). As much as strategies such as the marketing strategies adopted during the establishment and the introductory stages of an enterprise may spur growth of a manufacturing plant, studies conducted on the development and establishment of food processing plants still imply it is the management of the internal operations that may influence whether or not a processing plant will perform more effectively (Ayupp & Tudin 2014:172).

Internal cost and quality management affect the ability of most of the food processing plants to deliver on their business credo of offering enormous customer values in a way that cannot easily be matched by competitors (Safsten & Winroth 2011:3). To ensure a food processing plant delivers on its critical business credos, the manufacturing strategy adopted in the initial process of establishing a food processing plant is a critical prerequisite (Sorensen 2012:19).

A manufacturing strategy outlines critical activities and decisions that must be undertaken to enhance efficient and cost-effective utilisation of the strategic value creating resources of the firm in the production of the required goods or products (Duflou, Sutherland, Dornfeld, Herrmann, Jeswiet, Kara, Hauschild & Kellens 2012:587). It outlines relevant process structures offering a platform facilitating efficient flow of manufacturing activities in patterns that enhance a manufacturing plant's capabilities to deliver on its business credo of offering low cost and competitively better quality products (Ocampo & Clark 2015:29). It is through process structures' evaluations that the manufacturing executives are often able to select appropriate production processes that edify a manufacturing plant's overall operational efficiency and operational costs' significant reduction (Sorensen 2012:20). It influences manufacturing facility's layout, resource allocation, technology decisions and the adopted work methods (Lorenzi & Sorensen 2014:3). Depending on the type of technology, products, the degree of customisation, the required volumes and the stage of the maturity of the product in the product life cycle, a manufacturing plant may use job shop, batch shop, assembly line or continuous flow process structures (Wanniarachchi, Gopura & Punchihewa 2016:2).

The decision whether to use job shop, batch shop, assembly line or continuous flow is also determined by the extent to which such a process structure facilitates ease of activities' flow as well as process flexibility. It also depends on the products' volumes, capital investments, variable costs, labour content and the required skills (Despeisse, Oates & Ball 2013:31). However, the selected process structure may not necessarily influence effective performance of the manufacturing plant unless accompanied by frequent demand forecasting and resource planning (Harcharanjit & Rosli 2014:92). Demand forecasting and resource planning enhance the sustainability and growth of an enterprise. Demand forecasting aids assessment, identification and mitigation of the likely changes in demand and customer needs so as to plan the production and manufacturing schedules to effectively respond to such needs (Lorenzi & Sorensen 2014:3). It influences sourcing decisions in terms of quality, quantity and prices that must be paid to enable effective meeting of customers' needs and preferences. It enhances the improvement of inventory management and the minimisation of wastes associated with costs resulting from the mismatch of supply with demand.

To balance demand with supply, demand forecasting is often accomplished using a combination of judgmental, experimental, relational/causal and time series approaches (Yu, Choi & Hui 2011:7373). Forecasting results influence effectiveness of manufacturing resource planning decisions by using MRP (manufacturing resource planning) II to link manufacturing resource planning with other critical functions such as business planning, sales and operation, capacity requirements, and sales and marketing planning (Kind & Knyphausen-Aufseb 2007:176). It also edifies effective development and management of the master production schedule, bill-of-materials and inventory status file. In the master production schedule, the executives often outline the critical activities that must be accomplished from the process of sourcing raw-materials from the suppliers to the actual process of manufacturing and disposal. The completion of the process of demand forecasting and manufacturing resource planning influences effectiveness of capacity planning (Kind & Knyphausen-Aufseb 2007:176).

Capacity planning is the process of evaluation and planning whether the facilities, equipment, machineries, financial resources, technology and human resources that a firm has at its disposal can effectively enhance the production of the desired quantities and quality of products. This signifies a manufacturing strategy must be integrated with quality management systems and a culture of continuous research and innovation to foster continuous quest for improvement (Granato *et al.* 2010:292). It must also be accompanied by aggressive marketing and promotion to effectively position the products in the minds of the consumers and to outwit threats from other competitors. As the manufacturing strategy is being developed, it is also critical to integrate operational mechanisms for managing sanitary operations, and facilities such as freezers and coolers as well as the adoption of good equipment maintenance and calibration practices (Stellar 2014:5). It is the effective management of sanitary operations that fosters quality excellence in a food processing plant as well as the quality of its end products.

However, it is often still of significant importance that the management of sanitary operations is extended across the enterprise's business relationships and flow of activities along value chains spanning across farmers, processors, manufacturers, distributors, retailers to consumers (Stellar 2014:5). Such a view seems consonant with Wanniarachchi *et al.'s* (2016:2) argument that the development of a food processing plant is determined by clearly developed systems for sourcing, processing, storage, and shipping or distribution of finished products to the final consumers. In other words, it is evident that some theories explore the process of establishing a food processing plant. However, as most theories agitate for a largely scientifically skewed process for functional food development, poor interplay between science and business applications seems to continue to undermine effective development and commercialisation of functional foods derived from a variety of indigenous African plants (Lakefoods 2015:2; Norwegian Forum for Global Health Research 2011:11; The Council for Scientific and Industrial Research in South Africa (CSIR) 2013:2; Wrang 2015:19).

3. RESEARCH HYPOTHESIS

To resolve such a conceptual paradox, it is posited in the null hypothesis in Figure 1 that a scientific process intricately intertwined with critical business processes for the development of a functional food production plant catalyses its successful establishment, growth, sustainability and profitability.

To integrate such critical business processes in the scientific development and commercialisation of functional food production plants, it is argued that the process is predicted by four main phases of activities encompassing phase 1(assessment of customers' preferences for functional foods), phase 2 (scientific refinement of the concept's positive health implications), phase 3 (enterprise establishment and commercialisation of a functional food production plant), and phase 4 (evaluation of the effects of such a process on the development of a functional food production enterprise).

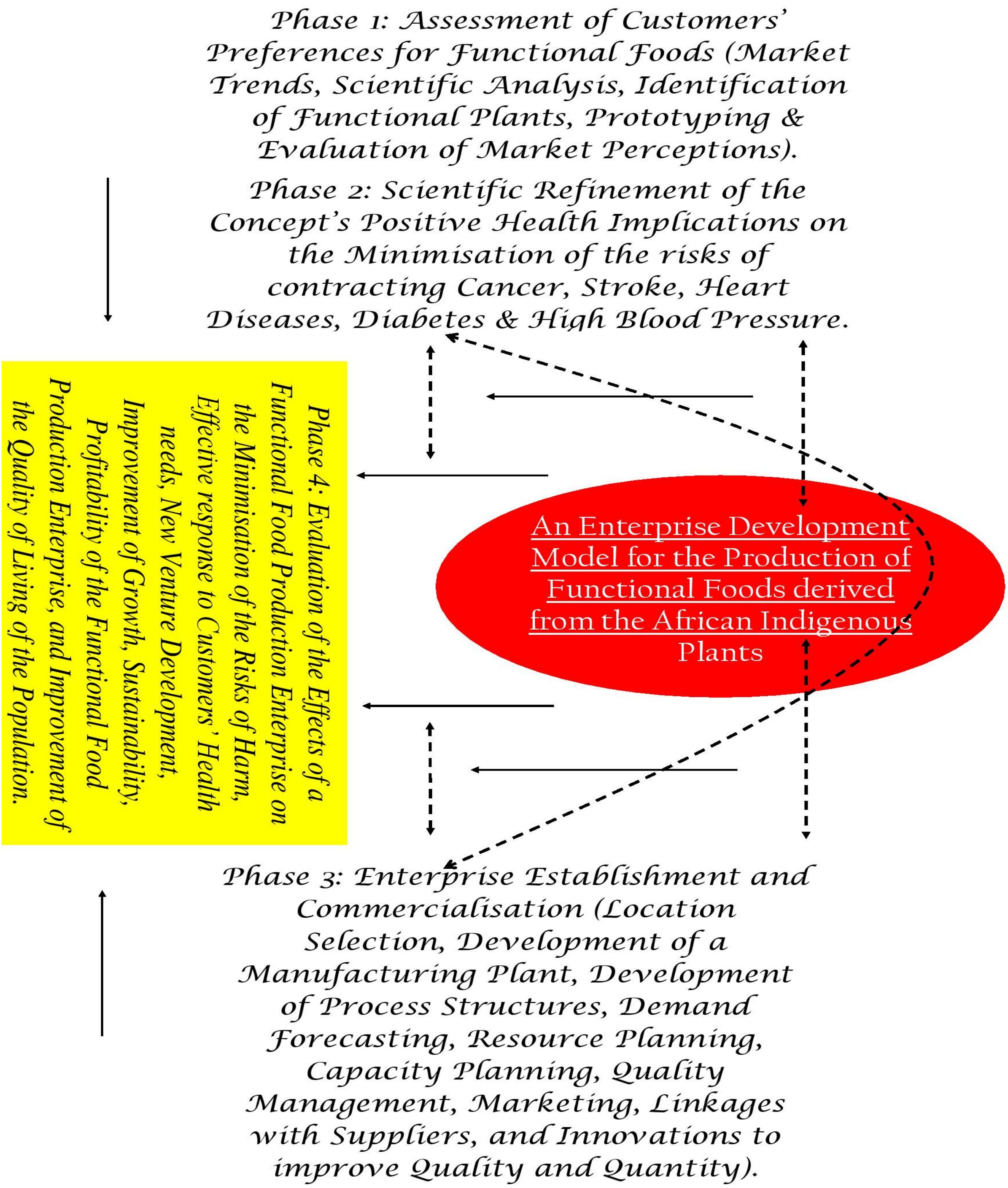

FIGURE 1: Underpinning research hypothesis on the an enterprise development strategy for the development of a functional food production plant

Source: As derived from linking Roberfroid's (2000:1660) scientific process of developing a functional food concept with enterprise development theories (Bharucha & Jules 2010:291; Ozen *et al.* 2012:472).

While drawing from Roberfroid's (2000:1660) concepts and strategy of functional food science, the first phase requires assessment of customers' preferences for functional foods. This may entail evaluation of the prevailing market trends, scientific analysis, identification of functional plants, prototyping and evaluation of market perceptions about the claimed positive health implications of the developed functional food concept.

Even if views from the market are supportive of the newly developed functional food concept, it is reiterated in the hypothesis in Figure 1 that it is still critical that further analysis and refinement of the concept are undertaken to improve its health attributes to effectively mitigate risks of contracting diseases such as cancer, stroke, heart failures, diabetes and high blood pressure.

Following the confirmation of the functional food concept that must be manufactured, businesses can then develop a manufacturing plant accompanied by an effective manufacturing strategy.

It is critical that such a manufacturing strategy outlines clear process structures and methodologies and techniques to be used in demand forecasting, resource planning, capacity planning, quality management, and further innovation to produce the desired quality and quantity.

The use of these two processes to integrate scientific and business processes of functional food development instigates the improvement of the growth, sustainability and profitability of the functional food production enterprise. Such a process also minimises risks of harm resulting from side effects that often arise from poor analysis and conceptualisation of functional food products. In other words, the study is underpinned by the research statement in the next section.

4. RESEARCH STATEMENT

Paradoxes of the poor interplay between science and business applications affects effective development and commercialisation of functional foods developed from a variety of the indigenous African plants to respond to the increasingly overwhelming business opportunities in the functional food industry.

5. PURPOSE OF THE RESEARCH

The purpose of this research is to test and develop an enterprise development strategy that businesses can replicate during the development and commercialisation of functional foods derived from a variety of the indigenous African plants.

6. METHODOLOGY

To extract an enterprise development strategy for the development and commercialisation of functional foods developed from a variety of the indigenous African plants, the study used multivariate analysis to test the model in Figure 1 (Barrett 2007:815).

The application of multivariate analysis was motivated by the fact that most of the studies on the production of functional foods derived from the indigenous African plants have been largely scientific (Granato *et al.* 2010:292; Ozen, Pons & Tur 2012:472; York *et al.* 2011:696). Such largely scientific studies affected the development of a strategy simultaneously linking scientific researching and testing functional foods to the process of a business development.

In effect, multivariate analysis is used in this study to fill that gap by testing and validating an enterprise development strategy intertwining science with business applications that businesses can replicate to aid the development of more vibrant functional food business concepts. To accomplish this, multivariate analysis was applied according to four steps encompassing path specification, sampling, data collection, path analysis and analysis of discriminant and convergent validly and reliability(Barrett 2007:815). Following path specification in Figure 1, sampling was undertaken by drawing 80 respondents from 10 and 30 firms respectively from the Ugandan and the South African food and beverage industries and the pharmaceutical industry.

6.1 Sampling

The use of one country from Southern Africa (South Africa) and East Africa (Uganda) was aimed at assessing how the local food and beverage firms as well as the pharmaceutical companies are taking advantages of the functionally rich indigenous African plants to develop functional products that enable them exploit enormous opportunities that are emerging in the African functional food industry. The use of the businesses in the two countries aided comparison and generalisation of strides and the associated paradoxes of the initiatives undertaken by the functional food manufacturers in the African continent to extract functional foods from the indigenous African plants.

Although business conditions and circumstances in different countries vary, such approach also enhanced generalisation of the enterprise development strategy that would be suggested for the establishment of functional food production plants not only for the businesses in South Africa, but also across the African continent. Such analysis was also inherently aimed at identifying whether there is any business model that the businesses have so far adopted. In effect, over a period of 9 months spanning between January and October 2016, 100 survey questionnaires were distributed as part of a series of other studies to the selected firms.

Using key employees selected as agents, constant follow-ups were undertaken so that if about 80% (80 questionnaires) of the 100 distributed questionnaires were completed and returned, the process of primary data collection would be closed for relevant statistical analysis to commence. The view that 80% (80 questionnaires) of the 100 distributed questionnaires completed and returned were suitable was in line with theoretical criterion that multivariate analysis can only be undertaken on a sample $(n) > 50$ (O'Boyle & Williams 2011:6).

6.2 Data collection

Data collection was accomplished using a five-point Likert-style survey questionnaire comprising of four sections aligned to the four constructs in the model in Figure 1. The first construct that assessed customers' preferences for functional foods (ACPFF) examined five latent indicators encompassing market trends (MT), scientific analysis (SA), identification of functional plants (IFP), prototyping (P), and evaluation of market perception (EMP).

The second construct which explored the essence of scientific refinement of the functional food concept's positive health implications (SRCPHI) was measured by cancer (C), stroke (S), heart diseases (HD), diabetes (D) and high blood pressure (HBP).

The third construct that evaluated the effectiveness of the process for enterprise establishment and commercialisation (EEC) was specified to be predicted by 10 latent indicators encompassing location selection (LS), development of a manufacturing plant (DMP), development of process structures (SPS), demand forecasting (DF), resource planning (RP), capacity planning (CP), quality management (QM), marketing (M), linkages with suppliers (LWS) and innovation to improve quality and quantity of the developed functional food concept (IQQ).

Finally, the fourth construct which explored the effects of the application of the strategy in Figure 1 on the development of a functional food production enterprise (EDFFPE) was specified to be predicted by minimisation of the risk of harm (MRH), instigation of effective response to customers' health needs (CHN), new venture development (NVD), improvement of growth (IG), sustainability (SUS), profitability of the functional food production enterprise (PRO), and improvement of the quality of living of the population (1QLP). To participate in the study, a respondent had to be a food scientist, a chemist, pharmacist or an employee with extensive knowledge of the food and beverage industry.

After about 80% (80 questionnaires) of the 100 distributed survey questionnaires were returned, the process of path analysis was undertaken using standardised regression weights and squared multiple co-relation coefficients to assess whether all the latent indicators significantly load onto their latent constructs (Barrett 2007:815).

6.3 Path analysis

For standardised regression weights, a factor loading > 0.50 was interpreted as significant, as for squared multiple co-relation coefficients, a criteria of $r^2 = 0 \leq r^2 \leq 1$ was used in the assessment of whether all the latent indicators were explained by the variance in the associated common factor (Barrett 2007:815).

Using a rule of thumb of x^2 p-value $>$ 0.05, x^2 was interpreted to imply sample covariance matrix matches the estimated SEM covariance matrix (O'Boyle & Williams 2011:6). The application of x^2 was accompanied by the use of x^2/df, root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis Index (TLI) and Normed Fit Index. Whereas the level of fitness for x^2/df was set at a ratio of 1 to 3, and RMSEA

< 0.08 for root mean square error of approximation, for CFI, TLI and NFI, values > 0.95 were interpreted to imply better model fitness (Barrett 2007:815; O'Boyle & Williams 2011:6).

As path analysis was being undertaken, discriminant and convergent validity and reliability analysis were also undertaken using average variance extracted (Ave), composite reliability (Cr) and averaged shared variance (ASV). Ave $> 0.5,$ Cr $> 0.7; >$ Ave, and ASV $< \sqrt{(Ave)}$ suggested good discriminant and convergent validity and reliability of the constructs and the strategy in Figure 1 (Kenny, Kaniskan & McCoach 2014:17).To improve the ethical considerations of the study, the research process only entailed the survey of the opinions of the respondents about the effectiveness of the critical processes and strategies used in the development and establishment of functional food production plants. In this process, it avoided suggesting or implying the functional benefits of foods derived from any scientifically untested indigenous African plants to minimise risks of harm or damage to the public or any form of vegetations or plants. The details of the findings are presented and discussed as follows.

7. FINDINGS

Findings are presented and discussed according to three subsections encompassing;

- face validity analysis
- chi-squared (x^2) and fit statistics
- standardised regression weights and squared multiple co-relation coefficients.

The details are as follows.

7.1 Face validity analysis

The argument that the use of an enterprise development model in Figure 1 would significantly edify effective development and commercialisation of a functional food production plant is echoed in the results of confirmatory factor analysis. Face validity analysis of the results of standardised regression weights and squared multiple co-relations coefficients imply the scientific process of conducting relevant analysis to identify health benefits of selected functional foods coherently links with the process of commercialisation.

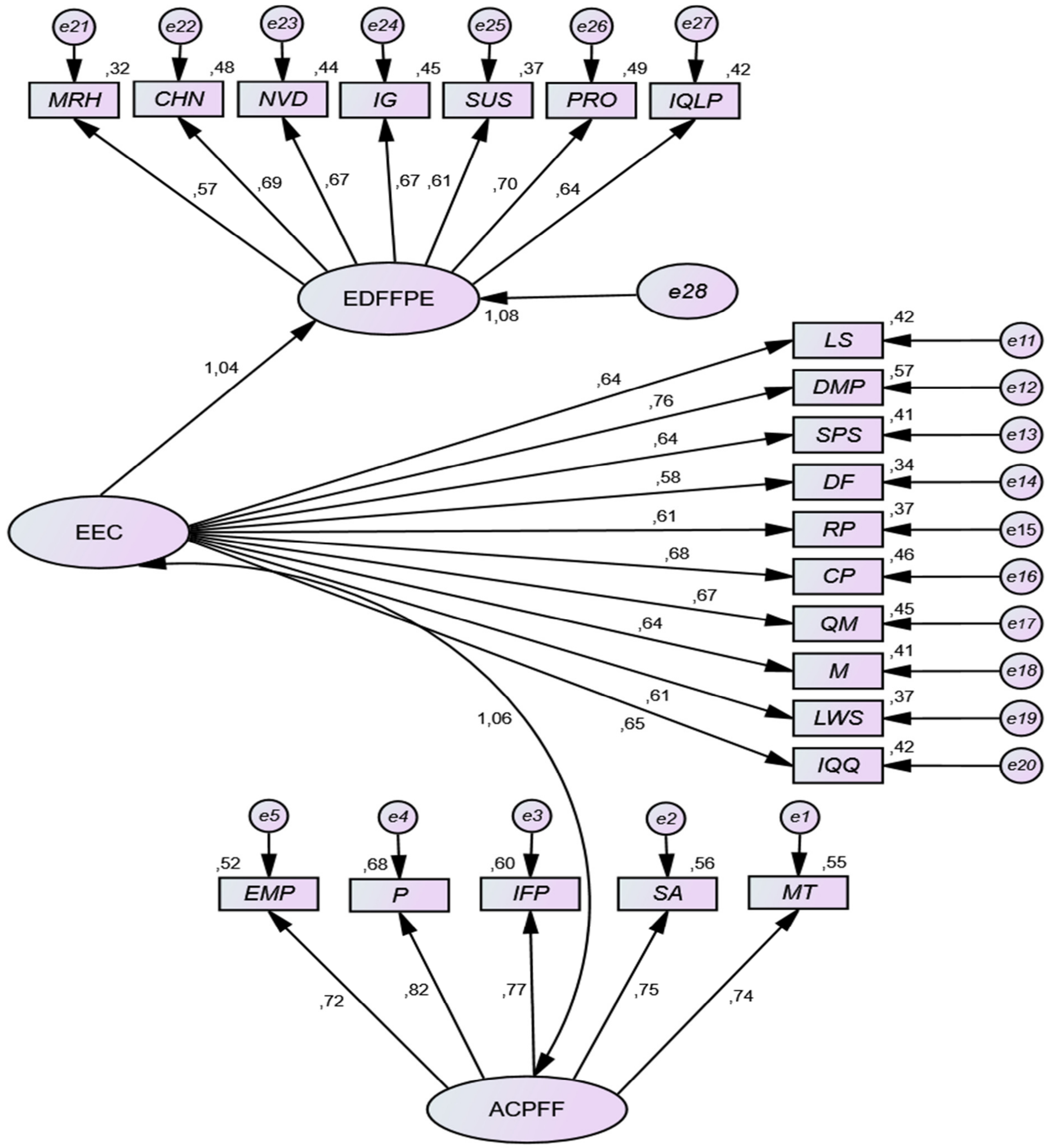

FIGURE 2: **Face validity analysis of the edifying effects of the relationship between Phase 1: Assessment of customers' preferences for functional foods - ACPFF), Phase 3: Enterprise establishment and commercialisation - EEC, and the Effects on the development of a functional food production enterprise-EDFFPE)**

Source: As extracted from the results of confirmatory factor analysis

This leverages the extent to which the innovators are able to obtain as enormous business values as possible from their concepts. Without the integration of the critical business process of refining and modifying the identified functional plants, the assessment of customers' preferences for functional foods co-relates more with the effectiveness of enterprise development at 1.

Its overriding effects on the effectiveness of the process for the development of a functional food production plant is further moderated by the interplay between market analysis and the strategic process of enterprise development that predicts the development of a functional food production enterprise (EDFFPE) at a statistically significant level of 1.

This interpretation is in line with the statistical views in confirmatory factor analysis theories that imply a co-relationship between two or more variables or sets of variables is significant if falling in the range between 0 and 1, just as a factor loading of $> .50$ is often interpreted to imply the specified latent indicators significantly load onto their associated latent constructs (Kenny, Kaniskan & McCoach 2014:17). In the context of the results in Figure 1, it is evident that it is not only these three constructs (assessment of customers' preferences for functional foods -ACPFF, enterprise establishment and commercialisation-EEC, and assessment of the effects of such a process on the development of a functional food production enterprise-EDFFPE) that are related to each other, but also their associated measuring variables.

In line with the statistical criteria of $\beta > 0.50$ (O'Boyle & Williams 2011:6), it can be interpreted that in terms of the first construct (phase 1: assessment of customers' preferences for functional foods-ACPFF), most of the measured variables were statistically significant. This is reflected in the fact that face validity analysis indicated market trends (MT) to load at 0.74, scientific analysis (SA) (0.75), identification of functional plants (IFP)(0.77), prototyping (P)(0.82), and evaluation of market perception (EMP)(0.72). As on the other hand, the process for enterprise establishment and commercialisation (EEC) is also reiterated in Figure 2 to be statistically explained by location selection (LS) (0.64) and development of a manufacturing plant (DMP) (0.76). The process for enterprise establishment and commercialisation (EEC) is also highlighted in Figure 2 to be statistically predicted by the development of process structures (SPS) (0.64), demand forecasting (DF)

(0.58), resource planning (RP) (0.61), capacity planning (CP) (0.68), quality management (QM) (0.67), marketing (M) (0.61), linkages with suppliers (LWS) (0.64), and innovation to improve quality and quantity (IQQ) (0.65).

The catalyzing effects of this co-relationship spurs improvement of the process for the development of a functional food production enterprise (EDFFPE) by minimising risks of harm (MRH) (.64), and instigating effective response to customers' health needs (CHN) (0.70). It also edifies effective new venture development (NVD)(0.61), improvement of growth (IG) (0.67), sustainability (SUS) (0.67), profitability of a functional food production enterprise (PRO) (0.69) and improvement of the quality of living of the population (1QLP) (0.57). In other words, the evaluation of market trends enables a firm to effectively understand and track customers' increasing preferences for healthcare needs and corresponding supportive functional foods. As the majority of the population attain the middle class status, the changes in life styles were found to cause diseases and concerns for health associated with diets and types of the consumed foods. Changes in lifestyles and consumption of certain foods tend to expose the population to risks of excessive obesity, diabetes, cancer and cardiovascular diseases that cause stroke and sudden deaths linked to heart failures.

However, to further assess the functional food production enterprise development model that can be suggested, the activities in the second phase that deals with scientific refinement of the concept's positive health implications (SRCPHI) were integrated and evaluated in Figure 3. The motive of such analysis was to evaluate whether after the identification of functional plants, further refinement of the concept in terms of how it minimises risk of cancer (C), stroke (S), heart diseases (HD), diabetes (D) and high blood pressure (HBP) improves the identification of the appropriate business model that can be replicated. The results of x^2 and fit statistics on such analysis are discussed in the next subsection.

7.2 Chi-squared (x^2) and fit statistics

It is the conventional statistical rule that a sample covariance matrix matches the estimated SEM covariance matrix if x^2; p-value > 0.05 (O'Boyle & Williams 2011:6). Whereas in this interpretation, x^2; p-value $= 0.000$ just indicates a perfect fit, values > 0.05 often imply better model fitness. However, in this research, x^2 = 363.055; df=345; $p - value = 0.000$; df=345 did not indicate good model fitness. Instead, it revealed just a perfect fit on the basis that $p - value = 0.000 >$ 0.05. This prompted the use of other parsimonious adjustment measures to minimise the effects of sample sizes by dividing x^2 with df as well as the other non-centrality and relative fit indices such as root mean square error of approximation and comparative fit index.

In terms of $Cmin/df$, x^2/df = 1.05233 was found to fall within the ratio of 1 to 3. It therefore suggests the use of the business strategy in Figure 1 would significantly edify effective development and commercialisation of functional foods developed from the indigenous African plants to effectively respond to the increasingly overwhelming business opportunities in the functional food industry.

Such a view is based on the fact that Hayduk, Cummings, Boadu, Pazderka-Robinson and Boulianne (2007:841) posit a $Cmin/df$ falling in the range of 1 and 3 to indicate good model fitness. Such a finding seems consonant with the theoretical reasoning in which some of the strategic management theories reiterate effective market and environmental analysis to influence the identification and modification of a business concept that must be undertaken to effectively respond to customers' needs and to diffuse market competitive threats. Although x^2 does not corroborate such results, the view that the hypothetical strategy in Figure 1 represents an appropriate enterprise development strategy that would enhance effective establishment and commercialisation of functional food products is further accentuated in the results of root mean square error of approximation which is one of the non-centrality parameter indices:

$$\sqrt{[(x^2 = 363.055) - (df = 345) = 18.055]} / \sqrt{[(df = 345(N = 80 - 1) = 27255)]}$$

$$\sqrt{18.055}/\sqrt{27255} = 4.24912/165.09088 = 0.02574$$

Using the rule that root mean square error of approximation < 0.08 signifies good model fitness (O'Boyle & Williams 2011:6), with values closer to zero indicating better model fitness, it can be interpreted that RMSEA $= 0.02574 < 0.08$ supports the fundamental business logic in Figure 1 that the process for the development of a functional food production plant is predicted by assessment of customers' preferences for functional foods

(ACPFF), scientific refinement of the concept's positive health implications (SRCPHI), enterprise establishment and commercialisation (EEC), and assessment of the effects of such a process on the development of a functional food production enterprise (EDFFPE). It implies the use of such analysis improves the conceptualisation of functional food products and the extent to which a firm is able to perfectly respond to the health demands and needs of the population.

The notion that it is such a process that improves the success of the functional food production plant is also echoed in the results of comparative fit index;

$$Cfi = \frac{d_{null}=[x^2_{null}\ (690.633)-df_{null}(279)]-d_{model}=[x^2_{model}\ (363.055)-\ df_{model}(345)],}{d_{null}=[x^2_{null}\ (690.633)-df_{null}(279)]}$$

Comparative fit Index = $\frac{(41.663)-(18.055)=393.578}{411.663} = 0.956074$

Although previously, the criterion for relative fit indices was normed between 0 and 1, recent theories on structural equation modelling indicate a consensus that it is only relative fit indices > 0.95 that indicate good model fitness (Kenny *et al.* 2014:17). Using the rule of thumb of relative fit indices > 0.95 (Kenny *et al.* 2014:17), it can be noted that it is not only $Cfi = 0.956074$ that indicate good model fitness, but also the results of Tucker Lewis Index (TLI);

$$Tli = \frac{\left(\frac{x^2_{null}=690.663}{df_{null}=279} = 2.47549\right) - \left(\frac{x^2_{model}=363.055}{df_{model}=345} = 1.05233\right) = 1.42316}{\left(\frac{x^2_{null}=690.663}{df_{null}=279} = 2.47549\right) - 1}$$

Tucker Lewis Index (TLI) = 1.42316/2.47549-1 (1.47549) = 0.96453,

$\text{Tli} = 0.96453 > 0.95$ corroborate the results of $Cmin/df$, Cfi and $Rmsea$ that the use of the enterprise development strategy in Figure 1 predicts effective development of a functional food production plant. However, that contrasts with the results of Normed Fit Index (Enders & Tofighi 2008:75);

$$Nfi = \frac{x^2_{null\,model}(690.663) - x^2_{proposed\,model}(363.055) = 327.608}{x^2_{null\,model}\,(690.663)}$$

Normed Fit Index (NFI) $= 0.47434$

Normed Fit Index (NFI) $= 0.47434 < 0.95$ does not imply good model fitness. However, that does not suggest that the model in Figure 1 is not fit for usage in the process for the development and commercialisation of a functional food production plant. Attributable to such a view is the fact that besides the results of discriminant and convergent validity and reliability analysis, $Tli, Cmin/df$, Cfi and $Rmsea$ still strongly support the results of standardised regression weights and squared multiple co-relation coefficients in Table 1 and Figure 3.

Results in Table 1 and Figure 3 indicate the process of developing and commercialising a functional food production plant to depend on the assessment of customers' preferences for functional foods (ACPFF), scientific refinement of the concept's positive health implications (SRCPHI), enterprise establishment and commercialisation (EEC), and assessment of the effects of such a process on the development of a functional food production enterprise (EDFFPE).

7.3 Standardised regression weights and squared multiple co-relation coefficients

From the analysis of the results of standardised regression weights and squared multiple co-relation coefficients in Table 1 and Figure 3, it can be noted the assessment of customers' preferences for functional foods (ACPFF) is significantly explained by all its measuring variables that include, market trends (MT) (0.77), scientific analysis (SA) (0.78), identification of functional plants (IFP) (0.75), prototyping (P) (0.82), and evaluation of market perception (EMP) (0.74).

This is further demonstrated by the fact that all these variables are significantly explained by the variance in the common factor (ACPFF) which implies effective market analysis, scientific analysis, identification of functional plants, prototyping and evaluation of market perceptions influence the initial process of the development and establishment of a functional food production plant.

Standardised Regression Weights (β-beta) and Squared Multiple Correlation Coefficients (r^2)			
Latent Constructs and Endogenous Variables	β -beta ($\beta > \pm .50$)	r^2 ($0 \leq r^2 \leq 1$)	Interpretation
ACPFF- Phase 1: Assessment of Customers' Preferences for Functional Foods			
MT-Analysis of Market Trends	0.77	0.59(59%)	Significant
SA-Scientific Analysis	0.78	0.60(60%)	Significant
IFP-Identification of Functional Plants	0.75	0.56(56%)	Significant
P-Prototyping	0.82	0.66(66%)	Significant
EMP-Evaluation of Market Perception	0.74	0.55(55%)	Significant
SRCPHI-Phase 2: Scientific Refinement of the Concept's Positive Health Implications			
C-Cancer	0.77	0.59(59%)	Significant
S-Stroke	0.63	0.39(39%)	Significant
HD-Heart Diseases	0.61	0.38(38%)	Significant
D-Diabetes	0.63	0.40(40%)	Significant
HBP-High Blood Pressure	0.68	0.46(46%)	Significant
EEC- Phase 3: Enterprise's Establishment and Commercialisation			
LS-Location Selection	0.90	0.81(81%)	Significant
DMP- Developing a Manufacturing Plant	0.95	0.90(90%)	Significant
SPS-Development of Process Structures	0.91	0.83(83%)	Significant
DF-Demand Forecasting	0.87	0.76(76%)	Significant
RP-Resource Planning	0.90	0.80(80%)	Significant
CP-Capacity Planning	0.93	0.87(87%)	Significant
QM-Quality Management	0.93	0.86(86%)	Significant
M-Marketing	0.92	0.84(84%)	Significant
LWS-Linkages with Suppliers	0.89	0.80(80%)	Significant
IQQ- Improvement of Quality & Quantity	0.90	0.81(81%)	Significant
EDFFPE-Effects on the Development of a Functional Food Production Enterprise			
MRH-Minimisation of Risks of Harm	0.95	0.91(91%)	Significant
CHN-Effective response to Customers' Health needs	0.96	0.93(93%)	Significant
NVD-New Venture Development	0.95	0.91(91%)	Significant
IG-Improvement of Growth	0.95	0.91(91%)	Significant
SUS-Sustainability	0.95	0.91(91%)	Significant
PRO-Profitability	0.97	0.95(95%)	Significant
IQLP-Improved Population's Quality of Living	0.97	0.93(93%)	Significant

TABLE 1: Results of standardised regression weights and squared multiple co-relations coefficients

Source: As extracted from the results of Confirmatory Factor Analysis of the model in Figure 1

Wrang (2015:1) reveals that with about 50% of the South Africa's 52 million people attaining the middle class status, the changes in the lifestyles were found to lead to the situation where 7% of the adult population are suffering from diabetes related diseases. This signifies for firms aiming to invest in the production of functional foods, thorough market analysis is critical in the conceptualisation stage for innovators to emerge with functional food concepts that perfectly match the health needs of the contemporary global population.

Such a view is also validated in the results of average variance extracted and composite reliability that indicated market trends (MT), scientific analysis (SA), identification of functional plants (IFP), prototyping (P), and evaluation of market perception (EMP) as critical indicators that predict the identification of a suitable functional food concept:

Average Variance Extracted (ACPFF):

$$Ave = \frac{\begin{matrix}[(0.77)^2 = 0.5929 + (0.78)^2 = 0.6084 + (0.75)^2 = 0.5625 \\ + (0.82)^2 = 0.6724 + (0.74)^2 = 0.5476] = 2.9838\end{matrix}}{2.9838 + \begin{bmatrix}(1-0.77) = 0.23 + (1-0.78) = 0.22 + (1-0.75) = 0.25 \\ + (1-0.82) = 0.18 + (1-0.74) = 0.26\end{bmatrix} = 1.14}$$

$$Ave = 0.72356 > 0.5 = \sqrt{(Ave = 0.72356)} = 0.85062$$

Composite reliability (ACPFF):

$$Cr = \frac{(0.77 + 0.78 + 0.75 + 0.82 + 0.74)^2 = 14.8996}{\begin{matrix}14.8996 + [(1-0.59) = 0.41 + (1-0.60) = 0.4 + (1-0.56) = 0.44 \\ + (1-0.66) = 0.34 + (1-0.55) = 0.45] = 2.04\end{matrix}}$$

$$Cr = 0.87957 > 0.7; > Ave = 0.72356 = \sqrt{(Ave = 0.72356)} = 0.85062$$

Average variance extracted > 0.5 suggests good discriminant and convergent validity and reliability of a construct, just as composite reliability $> 0.7; > Ave$ (O'Boyle & Williams 2011:6). In terms of the assessment of customers' preferences for functional foods (ACPFF), it can be construed $Ave = .72356 > 0.5$, and $Cr = 0.87957 > 0.7; > Ave = 0.72356$ signify the entire first construct (ACPFF) is explained by its endogenous variables and not any other exogenous factors. It supports the ratiocination in the null hypothesis in Figure 1 that effective market trends' analysis, scientific analysis, identification of functional plants, prototyping, and evaluation of market perception creates the solid business foundation that influences the effectiveness of the other stages to be accomplished in the process for the development of a functional food production plant.

In other words, it implies firms may emerge with a functional food concept after the effective accomplishment of the activities in the first phase in the model in Figure 1. However, further scientific analysis and refinement often improve how firms are able to evaluate the positive health implications of the functional food product on the minimisation of risks of cancer, stroke, heart diseases, diabetes and high blood pressure. As indicated in Table 1 and Figure 3, such a logic is statistically validated by the fact that scientific refinement of the concept's positive health implications (SRCPHI) enhances evaluation and improvement of the functional food concept to minimise the population's risks of contracting cancer (C) (0.77), stroke (S) (0.63), heart diseases (HD) (0.61), diabetes (D) (0.63) and high blood pressure (HBP) (0.68).

This is further validated by the fact that Table 1 and Figure 3 highlight all these endogenous variables are significantly explained by the variance in the common factor (SRCPHI). As accentuated in the results of average variance extracted and composite reliability, findings suggest further assessment and refinement of the functional food concept improves its health attributes to minimise risks of contracting different nutritional lifestyle diseases:

Average variance extracted (SRCPHI):

$$Ave = \frac{\begin{matrix}[(0.77)^2 = 0.5929 + (0.63)^2 = 0.3969 + (0.61)^2 = 0.3721 \\ + (0.63)^2 = 0.3969 + (0.68)^2 = 0.4624] = 2.2212\end{matrix}}{2.2212 + \begin{bmatrix}(1-0.77) = 0.23 + (1 - 0.63) = 0.37 + (1-0.61) = 0.39 \\ +(1-0.63) = 0.37 + (1-0.68) = 0.32\end{bmatrix} = 1.68}$$

$$Ave = 0.56936 > 0.5 = \sqrt{(Ave = 0.56936)} = 0.75456$$

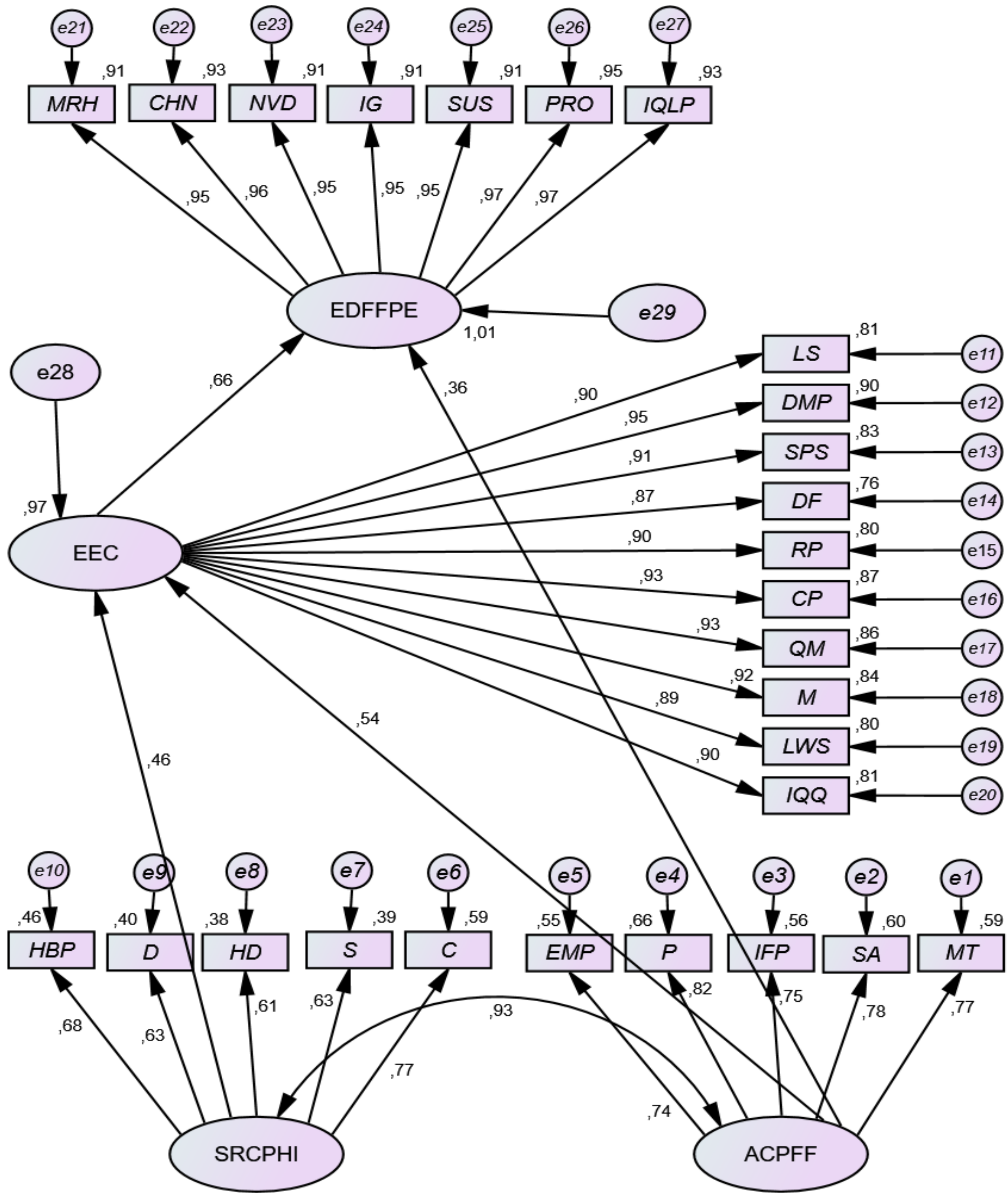

FIGURE 3: Results of standardised regression weights and squared multiple co-relations coefficients

Source: As extracted from the results of Confirmatory Factor Analysis of the pooled model in Figure 1

Composite reliability (SRCPHI):

$$Cr = \frac{(0.77 + 0.63 + 0.61 + 0.63 + 0.68)^2 = 11.0224}{11.0224 + [(1-0.59) = 0.41 + (1-0.39) = 0.61 \\ +(1-0.38) = 0.62 \\ +(1-0.40) = 0.6 + (1-0.46) = 0.54] = 2.78}$$

$$Cr = 0.79859 > 0.7; > Ave = 0.56936 = \sqrt{(Ave = 0.56936)} = 0.75456$$

Ave > 0.5 suggests good discriminant and convergent validity and reliability of a construct (Kenny *et al.* 2014:17), just as Cr $> 0.7; > Ave$. With $Ave = 0.56936 > 0.5$, and $Cr = 0.79859 > 0.7; > Ave = 0.56936$, it can be argued that after the identification of the functional food concept, further refinement enhances the precision to respond to the market's health needs.

The argument that this improves the success of the functional foods' production plant when it is established is demonstrated in the fact that the co-relationship between the analysis of customers' preferences for functional foods (ACPFF) and scientific refinement of the concept's positive health implications (SRCPHI) is significant at 0.93.

A co-relationship significantly predicting the functional foods production's enterprise's establishment and commercialisation at 0.46 and 0.54 respectively signifies as firms engage in analysis and in modifications and re-modifications of the functional food concept, it also edifies the understanding of customers' needs and the areas of customer concentration. During enterprise establishment and commercialisation (EEC), such information improves the executives' decision when deliberating on location selection (LS) (0.90), the development of a manufacturing plant (DMP) (0.95), development of process structures (SPS) (0.91), demand forecasting (DF) (0.87), resource planning (RP) (0.90), and capacity planning (CP) (0.93).

Effective understanding of customer needs also improves quality management (QM) (0.93), marketing (M) (0.92), linkages with suppliers (LWS) (0.89), and innovation to improve quality and quantity (IQQ) (0.90). In the context of the illustration in Figure 3 and Table 1, all these latent indicators are indicated to be highly explained by at least 80% of the variance in the common factor (EEC). However, it is not only the results of squared multiple co-relation coefficients that suggest all these variables are equally important in the process of the development and establishment of a functional food production enterprise, but also the results of average variance extracted and composite reliability.

Average Variance Extracted (EEC):

$$Ave = \frac{\begin{array}{c}[(0.90)^2 = 0.81 + (0.95)^2 = 0.9025 + (0.91)^2 = 0.8281 + (0.87)^2 = 0.7569 \\ + (0.90)^2 = 0.81 + (0.93)^2 = 0.8649 + (0.93)^2 = 0.8649 \\ +(0.92)^2 = 0.8464 + (0.89)^2 = 0.7921 + (0.90)^2 = 0.81] = 8.2858\end{array}}{8.2858 + \begin{bmatrix}(1-0.90) = 0.1 + (1-0.95) = 0.05 + (1-0.91) = 0.09 \\ +(1-0.87) = 0.13 + (1-0.90) = 0.1 + (1-0.93) = 0.07 \\ + (1-0.93) = 0.07 + (1-0.92) = 0.08 \\ + (1-0.89) = 0.11 + (1-0.90) = 0.1\end{bmatrix} = 0.9}$$

$$Ave = 0.57543 > 0.5 = \sqrt{(Ave = 0.57543)} = 0.75857$$

Composite Reliability (EEC):

$$\frac{(0.90 + 0.95 + 0.91 + 0.87 + 0.90 + 0.93 + 0.93 + 0.92 + 0.89 + 0.90)^2 = 82.81}{82.81 + \begin{bmatrix}(1-0.81) = 0.19 + (1-0.90) = 0.1 + (1-0.83) = 0.17 \\ + (1-0.76) = 0.24 + (1-0.80) = 0.2 + (1-0.87) = 0.13 \\ +(1-0.86) = 0.14 + (1-0.84) = 0.16 \\ + (1-0.80) = 0.2 + (1-0.81) = 0.19\end{bmatrix} = 1.72}$$

$$Cr = 0.97965 > 0.7; > Ave = 0.57543 > 0.5 = \sqrt{(Ave = 0.57543)} = 0.75857$$

$Ave = 0.57543 > 0.5$ and $Cr = 0.97965 > 0.7; > Ave = 0.57543$ imply discriminant and convergent validity and reliability of the construct of EEC to in turn suggest that a latent construct is measured and influenced by its associated endogenous variables in Figure 1 and not by any other exogenous indicators. In other words, findings indicate that as effective analysis is undertaken to identify and refine the functional food concept, it influences not only the process for the development of the functional food production enterprise, but also the extent to which the production plant is able to achieve most of its business objectives.

As reiterated in Figure 3 and Table 1, these enormous business values are often latent in the minimisation of the risk of harm (MRH) (0.95), effective response to customers' health needs

(CHN) (0.96), and new venture development (NVD) (0.95). It also edifies improvement of growth (IG) (0.95), sustainability (SUS) (0.95), profitability of the functional food production enterprise (PRO) (0.97), and improvement of the quality of living of the population (1QLP) (0.97).

Analysis of customer preferences for functional foods also directly predicts the performance of the functional food production plant at a statistically significant level of .36. Combined with the results of $Ave = 0.95531 > 0.5$ and $Cr = 0.9879 > 0.7; > Ave = 0.95531$, it is quite evident that effective analysis and refinement of the functional food concept enable executives determine the improvements that can be undertaken to improve the product's health attributes as well as minimisation of risks often associated with poor initial analysis.

Average Variance Extracted (EDFFPE):

$$Ave = \frac{\begin{gathered}[(0.95)^2 = 0.9025 + (0.96)^2 = 0.9216 + (0.95)^2 = 0.9025 + (0.95)^2 = 0.9025 \\ +(0.95)^2 = 0.9025 + (0.97)^2 = 0.9409 + (0.97)^2 = 0.9409] = 6.4134\end{gathered}}{6.4134 + \begin{bmatrix}(1-0.95) = 0.05 + (1- 0.96) = 0.04 + (1-0.95) = 0.05 \\ + (1-0.95) = 0.05 + (1-0.95) = 0.05 \\ + (1-0.97) = 0.03 + (1-0.97) = 0.03\end{bmatrix} = 0.3}$$

$$Ave = 0.95531 > 0.5 = \sqrt{(Ave = 0.95531)} = 0.9774$$

Composite Reliability (EDFFPE):

$$\frac{(0.95 + 0.96 + 0.95 + 0.95 + 0.95 + 0.97 + 0.97)^2 = 44.89}{44.89 + \begin{bmatrix}(1-0.91) = 0.09 + (1-0.93) = 0.07 + (1-0.91) = 0.09 \\ + (1-0.91) = 0.09 + (1-0.91) = 0.09 \\ + (1-0.95) = 0.05 + (1-0.93) = 0.07\end{bmatrix} = 0.55}$$

$$Cr = 0.9879 > 0.7; > Ave = 0.95531 > 0.5 = \sqrt{(Ave = 0.95531)} = 0.9774$$

It is through such initiatives that functional food production plants are able to effectively respond to customer needs by providing the required health benefits. This accurate response to customer needs influences increment in the rate of customer retention and new customers' attraction that in turn spur increment of profitability, growth and sustainability of the functional food production plant.

In other words, the argument that the use of the enterprise development model in Figure 1 enhance effective development and commercialisation of functional foods derived from the indigenous African plants is echoed in the results of discriminant and convergent validity and reliability analysis, $Tli, Cmin/df$, Cfi, $Rmsea$, and the standardised regression weights and squared multiple co-relation coefficients in Table 1 and Figure 3. It is also substantiated in the results of average shared variance for the entire pooled model in Figure 3 [Average Shared Variance = [(0.93)^2=0.8649 + (0.54)^2=0.2916 + (0.46)^2=0.2116+(0.66)^2=0.4356+(0.36)^2=0.1296 (1.9333)/4=0.48333].

It is the conventional statistical rule that average shared variance (ASV) $< \sqrt{(}Ave$ indicates good discriminant and convergent validity and reliability of the entire pooled model (Kenny *et al.* 2014:17). In terms of the overall discriminant and convergent validity and reliability of the pooled model in Figure 1, the analysis of the results in Figure 3 suggests that ACPFF: (ASV)= 0.48333 $< \sqrt{(Ave - Acpff\ =\ 0.72356)} = 0.85062$, SRCPHI: (ASV)= 0.48333 $< \sqrt{(Ave - Srcphi\ =\ 0.56936)} = 0.75456$, EEC: (ASV)= 0.48333 $< \sqrt{(Ave - EEC\ =\ 0.57543)} = 0.75857$, and EDFFPE: (ASV)= 0.48333$< \sqrt{(Ave - Edffpe\ =\ 0.95531)} = 0\ .9774$.

With all their associated variables, it is quite evident that the results of confirmatory factor analysis supports the fundamental business logic in Figure 1 that the process for the development and commercialisation of a functional food production plant is predicted by: the assessment of customers' preferences for functional foods (ACPFF), scientific refinement of the concept's positive health implications (SRCPHI), enterprise establishment and commercialisation (EEC), and assessment of the effects of such a process on the development of a functional food production enterprise (EDFFPE).

8. DISCUSSION

Increasingly, most of the population around the globe are increasingly seeking for functional foods with health benefits. Functional foods that minimise risks of contracting life style diseases such as cancer, heart failures, strokes, high blood pressure and diabetes. These increasing concerns for healthy lifestyles and foods among the contemporary consumers provide businesses in the functional food industry with enormous opportunities.

However, to reap these enormous business opportunities, the use of a model facilitating the intricate interplay between science and business applications seems a prerequisite. A scientific process intertwined with the process of enterprise development edifies analysis of whether the scientifically developed functional food concepts perfectly respond to the health demands and needs of the population. It enhances the evaluation of the overall market satisfaction and perception of the health benefits as well as risks linked to using the newly developed functional food concepts.

Orthodoxically, the scientific process for functional food development has often entailed analysis of health risks and identification of functional plants that are experimentally tested to assess and identify the functional attributes that can be further developed to provide functional benefits to the population (Bharucha & Jules 2010:291; Kind & Knyphausen-Aufseb 2007:176; Ozen *et al.* 2012:472; Sorensen 2012:20; Wanniarachchi *et al.* 2016:2). Such intensive scientific processes are usually undertaken in lieu of the adherence to the conventional process of enterprise development.

Even if such a scientific process leads to the development and establishment of a functional food production plant, lack of integration of certain critical business development strategies tends to limit the sustainability of such a production plant. Contrary to such scientifically skewed process of functional food development, confirmatory factor analysis indicated a four steps' model to facilitate effective interplay between science and business applications in the process for the development of a functional food production plant. These four steps encompass assessment of customers' preferences for functional foods, scientific refinement of the concept's positive health implications, enterprise establishment and commercialisation, and evaluation of the effects of such a process on the development of a functional food production enterprise.

The initial evaluation of market trends, scientific analysis, and identification of functional plants, prototyping and evaluation of market perception improves the precision at which the scientifically developed functional food concept is able to effectively respond to the health needs and demands of the consumers. Such analysis enables the understanding of the prevailing and the emerging new health needs of the population, so as to position the products in the way that facilitates effective response to the needs and demands of the consumers.

In such analysis, Roberfroid's (2000:1660) concepts and strategy of functional food science facilitate effective evaluation of the overall perceptions of the consumers and the general community about the health implications associated with the consumption of certain products. It also edifies the evaluation of the implication of the functional food on the reduction of the risk of pathological processes so as to determine whether or not the consumption of such food induces the claimed health benefits.

Even if such a process leads to the development of a vibrant functional food concept, it is still critical that further analysis and interactions with the consumers are undertaken to facilitate the understanding of emerging concerns. This enables scientific refinement of the concept's positive health implications to respond to the increasingly constant customers' quest to minimise risks of contracting life style diseases such as cancer, stroke, heart diseases, diabetes and high blood pressure. It spurs the extent to which the functional food concept is able to effectively perform on its market launch.

However, it is often not only the refinement of the business concept that may edify the functional food concept's successful market performance, but also the strategies used in the development of the production plant as well as the adopted manufacturing strategy.

Considering that a firm could have made an appropriate location decision, it is often of essence that as part of the manufacturing strategy, firms develop appropriate process structures. These are often accompanied by demand forecasting and resource planning, capacity planning, quality management, and investment in the opportunities for innovation and system enhancements.

Poorly designed manufacturing facilities can affect manufacturing costs, efficiency of the manufacturing processes, workflows, processes, quality, and productivity of the plant. All these can affect a firm's effective market performance, profitability and returns on shareholders' values. It can also limit the competitiveness of the functional foods' production plant as well as its growth in terms of market share, sales, revenue, profitability and returns on the shareholders' values.

Nevertheless, if all these processes that intertwine science with business is successful, it can spur minimisation of the risk of harm that often arise from poorly developed functional food concepts. It also instigates effective response to customers' health needs, new venture development, growth, sustainability and profitability and improvement of the quality of living of the population. This implies in order to extract and develop functional food concepts from the indigenous African plants, a number of managerial implications may also tend to arise for managers that aim to subsequently establish a functional food production plant.

9. MANAGERIAL IMPLICATIONS

To effectively respond to the recent paradigm shift from the traditional needs of nutrients and vitamins in favour of the emergence of a new self-care paradigm among the contemporary consumers, the entire findings of the study are associated with the following managerial implications. The managerial implications of the study are illustrated in Figure 4 to signify that businesses that aim to successfully invest in the production of functional foods derived from indigenous African plants must consider undertaking relevant environmental analysis to assess customers' healthcare needs and the alternatives offered by the competitors. To gain insight into the health concerns and needs of the population, it is critical thorough environmental analysis is conducted to understand the prevailing trends and the health concerns of the population.

Since functional foods are aimed at dealing with the emergence of lifestyle diseases, such analysis must focus on assessing lifestyle diseases that most of the people are struggling with. This must be accompanied by industry and market analysis to evaluate how the competitors or the existing functional food industry operators are effectively responding to such health concerns and needs. It must also focus on the assessment of how consumers presently use the provided functional foods. This will enable the identification of gaps and new challenges that must be addressed through the identification of functional foods that must be developed to address such health concerns of the population.

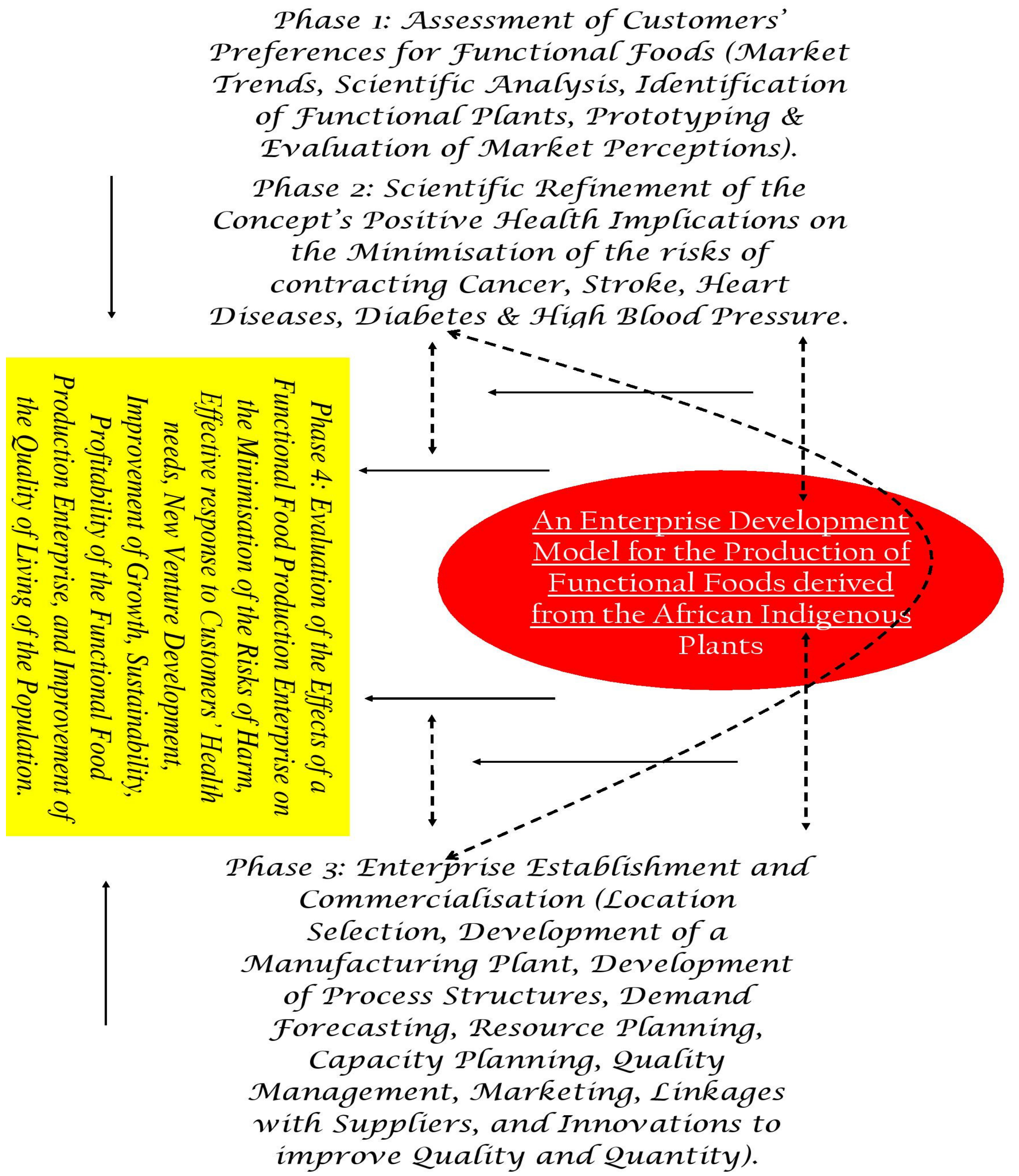

FIGURE 4: An enterprise development strategy for the development of a functional food production plant

Source: As extracted from the interpretation of the results of Confirmatory Factor Analysis of the pooled model in Figure 1

It therefore implies effective scientific research must be conducted to identify the indigenous African plants from which functional foods can be extracted and developed. In the accomplishment of relevant scientific research to identify the indigenous African plants from which the functional foods must be extracted and developed, the business will need not only to devote sufficient funds towards research, experimentation and testing, but also to forge partnerships and strategic alliances with research companies.

Alternatively, the business can also employ internal food scientists to undertake the necessary research and development (R&D).

To ensure the process of research and development is effectively accomplished, it is critical to adopt Roberfroid's (2000:1660) concepts and strategy of functional food science to enable the analysis of the overall perceptions of the consumers and the general community about the health implications associated with the consumption of certain products. It will also facilitate the evaluation of the implication of the developed functional food on the reduction of the risk of pathological processes so as to determine whether the consumption of such food induces the claimed reduction of the risk of the disease.

This will enable businesses emerge with certain sets of assumptions about the positive health implications of certain functional foods derived from the indigenous African plants, and to undertake scientific analysis to test and confirm the hypothesis about the positive health implications that such products are espoused to induce on the population. After the identification and confirmation that a particular indigenous African plant holds certain functional values, businesses can then commit the necessary resources to refine the concept and develop more secure sources of supplies. This reasoning is linked to the argument that although certain identified indigenous African plants may have certain functional values, they are often in limited supplies.

Considering the competition from the pharmaceutical companies, this can also affect the establishment and sustainability of the functional food production plant. To ensure the sustainability of the sources of supplies, it is of essence that after the refinement of the conceptualised functional food concept, the business must develop a stable source of supplies by developing own farms to produce the identified indigenous African plants.

Businesses can also financially support farmers of the identified indigenous African plants or motivate government to financially support the farmers of the identified indigenous African plants. With a refined functional food concept and established steady sources of supplies, the business can therefore select the location and establish the functional food manufacturing plant. However, for such plant to operate more effectively, it will still require an effective manufacturing strategy. A manufacturing strategy must not only outline the critical operational processes and activities, but also the issues of how demand forecasting and production scheduling, capacity planning and management, throughput control, quality management and constant innovation will be undertaken to improve the dynamic capabilities of the functional food manufacturing enterprise.

In most of the cases, the functionality of the functional foods is undermined by poor storage, transportation and distribution that may either cause termination or other forms of interferences that affect the functionality of functional foods. To maintain or improve the functionality of functional foods, it is argued that the business must adopt an appropriate system for managing storage, transportation, distribution and the entire value chains to avoid compromise of quality and functionality of functional foods. As such measures are accompanied by effective marketing and promotion, it is critical to also improve the awareness of the population about the existence of the new functional foods. Effective marketing and promotion by pointing out the health implications on the prevention or cure of diseases such as cancer, stroke, heart diseases, diabetes and high blood pressure can spur increment of the market outreach to influence increment of sales, revenues, profitability and subsequently the overall sustainability of the functional food production enterprise.

10. CONCLUSION

The increasingly changing customers' tastes and preferences for functional foods offer enormous opportunities for the contemporary food and beverage manufacturers. However, as much as some of the businesses have been able to establish more effective functional food production plants to respond to such enormous opportunities, the extraction of functional foods from most of the indigenous African plants seems to have not been optimized to respond to such opportunities. Yet, increasingly, studies are revealing most of the indigenous African plants to be significantly associated with enormous functional nutrients.

Paradoxes were reiterated to be related to the challenge of the enterprise development strategy that businesses can adopt to facilitate the interplay between science and business applications to improve the development and commercialisation of functional foods developed from the indigenous African plants. Such paradoxes were found to limit the ability of most functional food manufacturers to respond to the increasing overwhelming business opportunities in the functional food industry.

Although this research addresses such a challenge by suggesting the hybrid enterprise development strategy in Figure 4, future research can still explore the implications of marketing and promotion on the growth and sustainability of a functional food production plant.

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