ISSN 0511-5728
The West Indian Journal of Engineering
Vol.42, No.1, July 2019, pp.51-56

Evaluating New Product Development Processes in the Food and Beverage Manufacturing Sector of Trinidad and Tobago

Satira Bajnath[a], and Umesh Persad[b, Ψ]

The University of Trinidad and Tobago, San Fernando Campus, Tarouba Road, San Fernando, Trinidad and Tobago, West Indies
[a] Email: satira.bajnath@gmail.com
[b] Email: umesh.persad@utt.edu.tt

[Ψ] *Corresponding Author*

(Received 11 September 2018; Revised 12 April 2019; Accepted 08 May 2019)

Abstract: *This paper describes a study of the new product development process within the food and beverage manufacturing sector of Trinidad and Tobago. A total of twenty-three (23) companies agreed to participate in the study. They were contacted using the Trinidad and Tobago Manufacturers' Association (TTMA) database and social media. Current models and practices for the new product development process were evaluated and analysed and key activity stages were selected for the study. The stages that were assessed were market assessment, idea screening, prototyping, core development, testing and industrialisation. The findings revealed that the companies focused heavily on the industrialisation stage and did not uniformly adhere to the other stages of the process. It was also found that the companies lacked formal sensory programmes. It is recommended that companies improve their new product development practices to align with best practice. In addition, an integrated sensory framework could be used to quantify the sensory characteristics at each key stage of the product development process.*

Keywords: *New Product Development Process, Design Process Improvement, Descriptive Sensory, Food and Beverage Manufacturing*

1. Introduction

The third largest contributor to Gross Domestic Product (GDP) and the second largest sub manufacturing industry in Trinidad and Tobago is the food and beverage manufacturing sector (Investt, 2017). There was significant growth in the sector in the year 2016 as the sub industry grew by 11.5% but it is projected to plateau as there was a minimal decline of 0.1% during 2017 (GORTT, 2017). Notwithstanding that the food and beverage manufacturing sector has a significant share of 53% of the manufacturing sub-sector, its contribution to GDP is as little as 3.5% (GORTT, 2017). This presents an opportunity within this sector for diversification and innovation (Bizcommunity, 2017).

In the food and beverage sector, innovation is most commonly presented as a new product or upgraded item. Innovation and new products create market excitement, revive organisations and competitively position the organisation by transforming market demands into a physical commodity and can therefore lead to successive growth (Bizcommunity, 2017).

2. Background and Review

The successful introduction of new products is critically important for the survival and growth of companies (Lee and O'Connor, 2003). Locally, large firms relied on internal research and development to create new products and to remain competitive (Motilal et. al, 2014). KC Candy Limited and Angostura Limited were analysed by Swift (2014) who stated that multidisciplinary teams were used in both companies. This supported the theory by Sosa and Mihm (2008) which states that inputs from both marketing and technical sides of the business are required. The process of developing new products can be specific to an industry or benchmarked from standards (Rudder, Ainsworth and Holgate, 2001). Another critical aspect of the success of product development efforts is based on the involvement and support of senior management (Schimmoeller, 2010). This is in alignment with Crawford (1972) who stated that it is important to ensure that the organisation's new product strategy provides a unified direction to ensure successful new product development.

There are several models that are proposed within the field of product development that incorporate the multidisciplinary contributions of the key elements of the process. One such model was discussed by Baker and Hart (2007) who stated that sequential product development is based on the 'stage-gate' theory, where each stage is independently conducted by a department. Critics of this process, such as Wright and Race (2005) presents that it allows room for much error as it fosters one-way communication. Most authors still regard this

model as the most efficient approach to new product development as its sequential nature allows maximum control as stated by Cooper (1996) and Thomke (2007). There are three main models which are utilised for sequential new product development. These were proposed by Perreault and McCarthy (2006), Annachino (2007) and Kotler and Keller (2009). The number of steps in each model differs with the broad categories remaining constant. Perreault and McCarthy (2006) proposed a considerably short model consisting of only five stages which was reviewed and analysed by Annachino (2007) who proposed a six-stage model. This was then revised by Kotler and Keller (2009) to propose an eight stage model. These models refer to general product development and include elements of marketing and business development.

Product development within the food industry was analysed to focus on five critical areas as proposed by Czapski (1995). These five steps were viewed as critical for food product development. Earle et al. (2001) demonstrated the activities and outcomes of food product development by further evaluating the five steps proposed by Czapski (1995). The models presented by Czapski (1995) and Earle et al. (2001) contrasted with the models proposed by both Perrault and McCarthy (2006) and Kotler and Keller (2009). Perrault and McCarthy (2006) did not make any reference to testing in the model while Kotler and Keller (2009) referred to concept development and testing but did not make reference to testing within the product development stage.

Given that there are several proposed models for the new product development process, it was of great benefit to use a thematic summary of the studied models, which concisely represented various major activities. Table 1 summarises the major activities required in the new product development process. The models from which the parameters were adapted are listed as the model of derivation and other models that made reference to elements of the parameters are also listed. This framework was used to analyse the product development processes of food and beverage manufacturing companies in Trinidad and Tobago.

3. Methodology

Given that the study was focused on the food and beverage manufacturing sector of Trinidad and Tobago, the project scope was confined to three (3) criteria below:

1. The company must be a manufacturer of either food or beverage products,
2. The company must be legally registered to be considered, and
3. The manufacturing facility must be located in either Trinidad or Tobago.

When conducting qualitative research, it is of great importance to obtain participants who are familiar with the subject matter (Cresswell and Plano Clark, 2011). This may result in a limited number of suitable participants (Patton, 2002) as it is further limited by the participants' availability and willingness to contribute (Bernard, 2002). Local databases such as the Trinidad and Tobago Manufacturer's Association's (TTMA) membership directory and the Trinidad and Tobago Companies Registry were used to obtain names of legally registered food or beverage manufacturers within Trinidad and Tobago. The social media platform, Facebook, also provided useful communication channels with food manufacturers, which allowed positive soliciting of participants. A total of 56 companies were contacted for participation however, only 23 companies made the time available to facilitate the interview. This yielded an overall response rate of 41.1%.

Data was collected using a semi structured interview over the telephone or in person. All responses obtained from the interviews were useable, giving a completion rate of 100%. The companies that participated in the research covered a broad spectrum within the food and beverage manufacturing sector, including manufacturers of snack foods, coffee, juices, water, beer, confectionery, frozen pizza dough, wheat, meat, drink concentrates, condiments and ice popsicles. The companies were then assessed to determine the following:

Table 1. Major Activities Required for Food Product Development

Parameters	Model of Derivation	Models That Reference Parameters
Market assessment	Annachino (2007)	Czapski (1995), Earle et al. (2001), Perreault and McCarthy (2006), Kotler and Keller (2009)
Idea screening	Earle et al. (2001), Perreault and McCarthy (2006), Kotler and Keller (2009).	
Prototyping	Annachino (2007)	Czapski (1995), Earle et al. (2001), Perreault and McCarthy (2006), Kotler and Keller (2009)
Core / Product Development	Annachino (2007)	Czapski (1995), Earle et al. (2001), Perreault and McCarthy (2006), Kotler and Keller (2009)
Testing (analytical, sensory, market)	Czapski (1995)	Earle et al (2001)
Industrialisation (or commercialization)	Annachino (2007)	Czapski (1995), Earle et al. (2001), Perreault and McCarthy (2006), Kotler and Keller (2009)

* - The term 'industrialisation' refers to the inclusion of the new product as a manufacturing item. The term used by Perrault and McCarthy (2006) and Kotler and Keller (2009) to describe this activity is 'commercialisation'.

1. The factors that drive the new product development process.
2. The departments involved in the new product development process.
3. The engagement of the company in each key activity that was identified in Table 1 which were: a) Market assessment, b) Idea Screening, c) Prototyping, d) Core Development, e) Testing, and f) Industrialisation.

4. Results and Analysis

Based on the interview data, the factors that influence the new product development process were analysed to understand what drives the process and the departments that are involved in the process. These factors are described, as follows.

4.1 Factors Driving the New Product Development Process

The factors that drove the organisation to engage in new product development activities are depicted in Figure 1. The top three factors that influence the process were listed as market/sales trends, brainstorming and customer feedback. These findings align with general new product development practices where ideas for new products originate with current trends and customer feedback. However, for some companies, the market assessment may not be formalised or in depth as described in Section 5.3. New ideas are also generated internally via brainstorming.

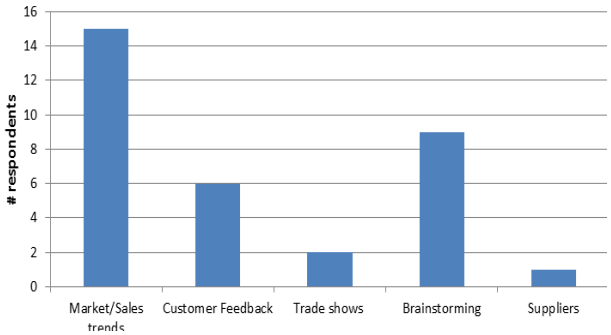

Figure 1. Factors that drive the new product development process

4.2 Departments Involvement in the New Product Development Process

The product development process involves many departments and based on the background research, it was noted that multidisciplinary teams yielded better success rates. As such, the involvement of a cross functional departments was evaluated. A breakdown of the departments involved in the process is shown in Figure 2 where the most commonly involved departments were found to be executives, quality, sales and marketing and production. Interestingly, Research and Development (R&D) showed relatively little involvement in the new product development process.

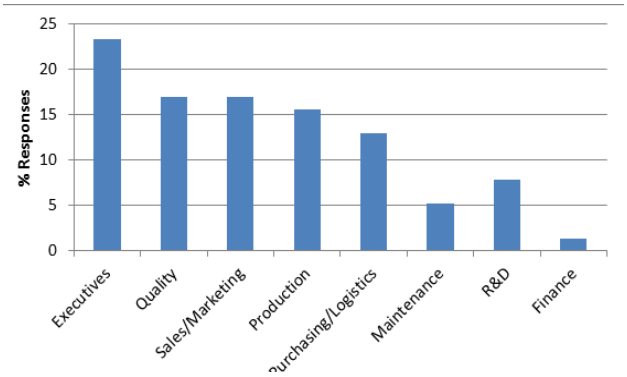

Figure 2: Departments involved in the new product development process

4.3 Company Engagement in Key Activity Areas

The key activities within the new product development process were evaluated against established models to understand whether the company engaged in the said activity. Figure 3 shows the percent responses of the companies for each stage of the new product development process. The only activity that solicited 100% response was industrialisation. Other activities were selectively performed depending on the company. The activity that had the lowest level of involvement was market evaluation as many respondents stated that they did not view the activity as important.

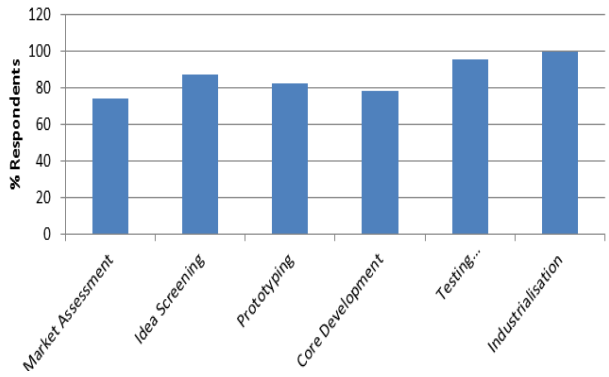

Figure 3. Percent response showing the involvement of the company at each stage

The findings revealed several challenging areas in each activity stage of the new product development process. The most common challenges of each stage of the product development process were individually analysed and recommendations were provided for each issue. A summary of the findings, challenges and

recommendations for each stage is represented in Figures 4 to 9.

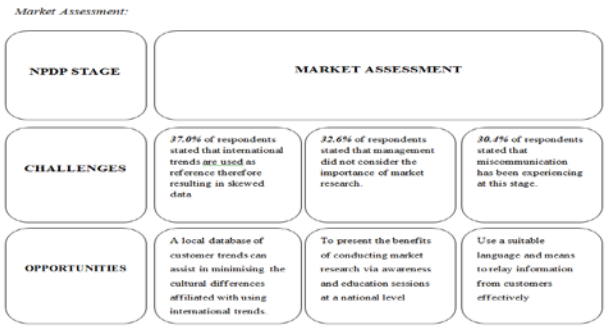

Figure 4. Challenges and opportunities in the market assessment stage

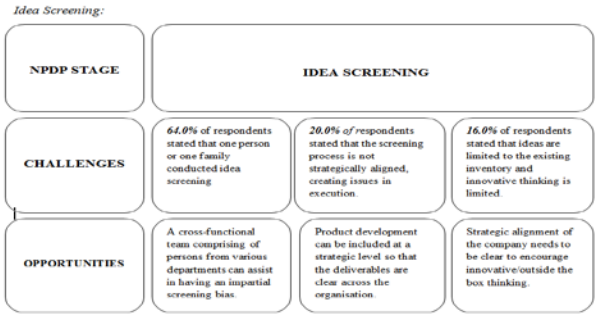

Figure 5. Challenges and opportunities in the idea screening stage

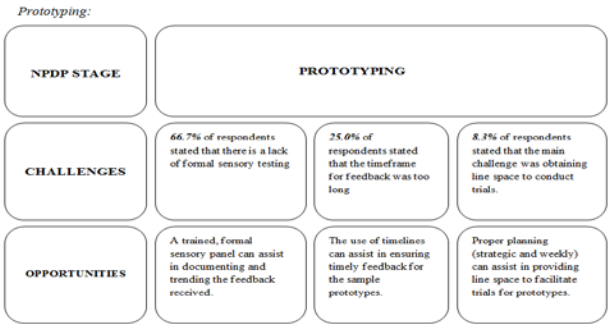

Figure 6. Challenges and opportunities in the prototyping stage

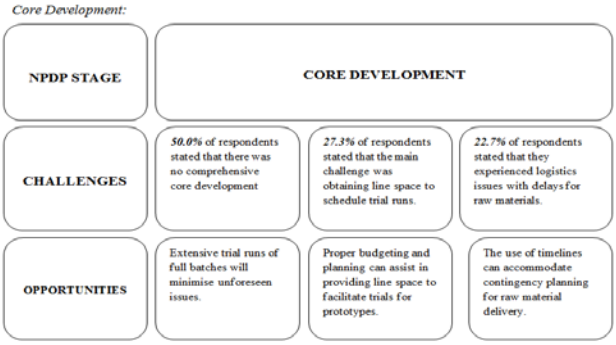

Figure 7. Challenges and opportunities in the core development stage

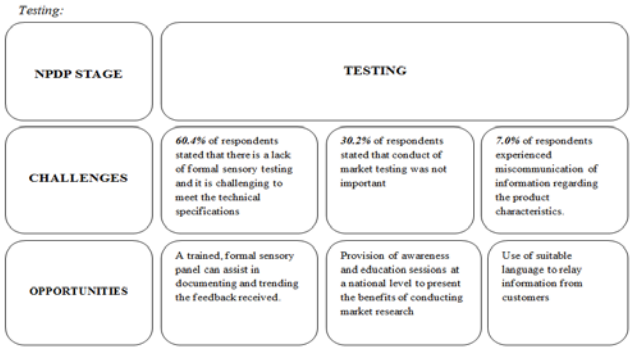

Figure 8. Challenges and opportunities in the testing stage

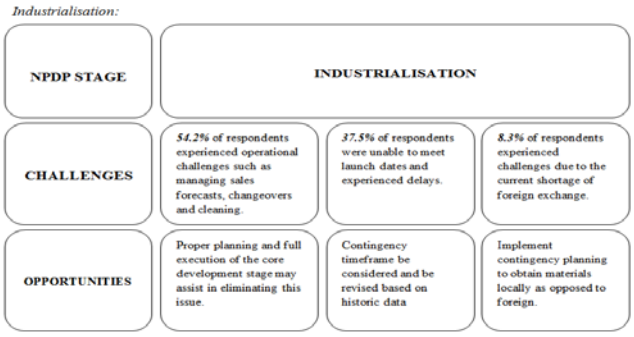

Figure 9. Challenges and opportunities in the industrialisation stage

After careful consideration of the major challenges and areas of opportunities within each stage of the new product development process, general recommendations were made for improvement of the new product development process.

5. Discussion and Recommendations

The findings of this research revealed that there is no fixed process that is used within the food and beverage manufacturing sector for product development. The opportunities that were identified could assist in establishing a thorough process which could benefit the company by allowing the design of a product to match the customer needs. This would result in a product that is well accepted by the market. The key stages that were identified and analysed were:

1. Market assessment,
2. Idea screening,
3. Prototyping,
4. Core development,
5. Testing, and
6. Industrialisation.

The inclusion of technical activities such as prototyping and core development allows the manufacturer the opportunity to test the product within the environment in which it is being manufactured therefore providing data that could assist in determining efficiencies, outputs, process losses, and changeover

times. This information allows the manufacturer to determine an accurate cost of goods prior to the launch of a product and could eliminate unnecessary costs after the product is launched in the market. The main recommendations are proposed to assist in a robust product development process. These are explained as follows

5.1 Implementation and Access to Local Consumer Database

Market trends and research on consumer behaviour are easily obtained from international market research, which as mentioned by 37% of respondents, is used by local companies to predict consumer behaviour on the local market during the market assessment stage. The use of international market trends could lead to incorrect projections as there are cultural differences that may not be representative of the local market. As such it is recommended that a local database could be established to assist manufacturers in understanding the needs of its customers. This would provide meaningful insight into consumer behaviour and customer trends on the local market. In addition, it would allow manufacturers to contrast the needs of the local and international markets, and develop business strategy to align to the similarities and differences in these markets.

5.2 Formalisation of a Sensory Programme

Successful food product development is dependent on how well the need of the customer is met by developing a desired product. The desired product characteristic is defined by means of its sensory attributes. The sensory characteristics therefore become very important as this provides a language to effectively relay information from customers. The introduction of a formal sensory programme to measure and record product characteristics could assist in multiple stages that were evaluated in the new product development process. This would help to clarify the desired product characteristics and quantitatively measure and record feedback.

5.3 Determination of Product Characteristics

The desired product characteristics are typically obtained in the initial stages of market assessment and the testing stage. Many respondents (some 30.4%) stated that miscommunication was experienced when interpreting the feedback provided. 7% of respondents experienced a similar issue when interpreting feedback provided at the testing stage prior to industrialisation. The use of clear descriptive sensory terminology is recommended to minimise miscommunication. This ensures that suitable terminology is used when describing the preferred product characteristics. As a result, the implementation of such could reduce the project timeline since it accurately pinpoints the areas of the product that needs to be modified or enhanced.

5.4 Measuring and Record of Feedback

In the prototyping stage 66.7% of respondents stated that there was no formal sensory testing conducted on the prototypes. The preferred samples are typically selected by the owners of the companies who decide based on personal preference. Similarly, in the testing stage there were 60.4% of respondents who stated likewise. These companies were therefore unable to meet the technical specifications of the desired product. It is recommended that a trained sensory panel be used to document and trend feedback so that the data obtained is consistently recorded. This could assist to quantitatively chart the key sensory characteristics of the product using calibrated panellists. According to Civille and Carr (2015), a calibrated panellist is trained to use a measurable scale when evaluating a sample. It is comparable to an instrument that requires regular calibration.

5.5 Inclusion of New Product Development at a Strategic Level

It is recommended that product development be included at a strategic level across multiple departments so that the deliverables are clear across the organisation. Such strategic alignment of the company needs to be clear to encourage innovative/outside thinking, while still complying with budgetary constraints and time constraints for launch. This recommendation could improve the activities at various stages of the product development process.

6. Designing a Sensory Framework

Several issues were addressed by recommending the formal implementation of a sensory programme. This provides a feasible opportunity for a sensory framework to translate and quantify the consumer's perception into an understandable language that could be measured and rated by the companies. This could be done either by being implemented in organisations or by contracting a specialised consultancy service.

Results show that companies and employees utilise varying terminologies to describe the same product characteristic in the Food and Beverage manufacturing sector. A sensory framework that is specific to product development would align the key stages of the new product development process with the type of sensory analysis that is required. This would allow for better feedback from both internal and external customers and consumers. It would also assist in cost savings when redoing prototypes or tweaking the product during the core development stage as the product definition is more vivid thus making it easier to adjust technical specifications to achieve the desired product.

A proposed sensory framework was developed (see Figure 10). The framework was presented to the participant companies for preliminary feedback, and 17 companies (some 73.9 % of respondents) stated that the

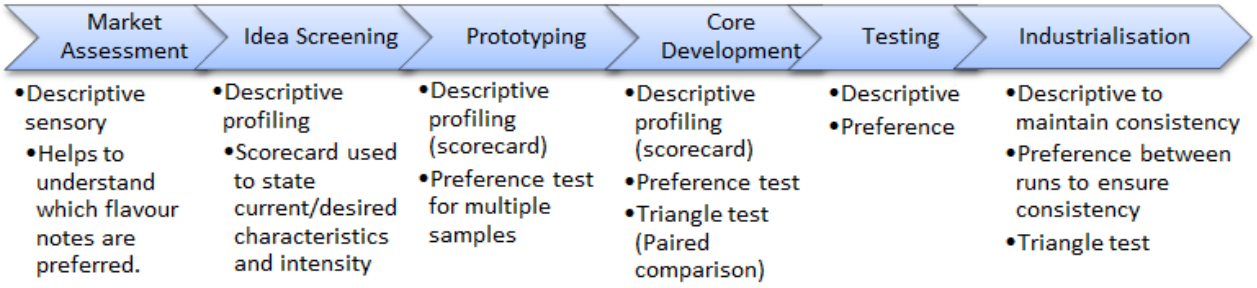

Figure 10. Proposed Template for Sensory Framework

proposed sensory framework could be beneficial in the new product development process.

The implementation of a sensory framework to assist in product development could result in cost savings as the desired sensory characteristic of the new product could be quantitatively documented and evaluated at each process step. This reduces the number of prototypes and trials that is required to meet the desired sensory characteristic of the market. An outline is presented below for each stage of the new product development process.

6.1 Market Assessment

The major challenges in the market assessment stage that was experienced by companies who engaged in this step were the use of international data and miscommunication of the customer's needs. The implementation of a descriptive sensory session at this stage could allow the company to understand the key sensory characteristics of the desired product (Sensoryanalysis.com, 2015). This therefore could assist companies to understand the desired sensory characteristics of the product that they are benchmarking against. It also provides the company with a competitive advantage to exceed the customer's expectations by improving on specific characteristics that may be mentioned.

6.2 Idea Screening

The major challenge experienced by companies in this stage was that the screening process was done by one person or one family. The use of sensory profiling to evaluate the product characteristic and its corresponding intensity may eliminate the ambiguity associated with relying on a small sensory panel. The sensory characteristics could be clearly iterated and transferred from one product development stage to another. This would positively impact on the speed of execution of the project as the quantitative component is now used as the premise for the prototyping stage.

6.3 Prototyping

The lack of formal sensory testing was unanimously listed as the biggest challenge in this process stage. The use of preference tests and sensory profiling is commonly used in the food industry to discern the difference between samples (O'Sullivan, 2017). This would surely provide a benefit to many companies within the industry.

6.4 Core Development

The major challenges within this process stage was operational issues such as not obtaining line space to schedule trials, delays in receiving materials and not comprehensively conducting the development work. The use of preference tests and sensory profiling at this stage of development could assist manufacturers to ensure that the desired product could be replicated on the production line on full scale or half scale batches. These sensory tests could also be used at this stage to evaluate the differences in raw materials when deciding to source from an alternate supplier or a new raw material.

6.5 Testing

The lack of formal sensory testing was again listed as the biggest challenge in this process stage. It was also noted that there was miscommunication of the product characteristics when market testing was conducted. The use of descriptive sensory and preference testing could be beneficial to the companies to ensure that the necessary feedback regarding which prototype or which sensory characteristic was preferred by the consumer.

6.6 Industrialisation

The major challenges in this stage were operational challenges as the respondents indicated that they experienced deterrents in meeting the stipulated launch date and issues with managing the sales forecasts. The use of descriptive sensory testing, preference testing and triangle tests could be beneficial to the companies to ensure that the sensory characteristics and quality of the product remains consistent over the course of the industrialisation and the product life span.

7. Conclusion

In achieving the research objectives of this study, it was apparent that there is a discrepancy in the new product development process in Trinidad and Tobago when compared to international practices. The only stage

within the new product development process that solicited a 100% response was industrialisation, which demonstrates a major challenge whereby local food and beverage manufacturing companies are not effectively executing key stages of the process. This problem could be alleviated by increasing awareness of these problems and then encouraging new product development activities at a strategic level in local organisations.

Another major challenge is the inability of the companies to extract, understand and interpret consumer needs when assessing the market or conducting testing. Recommendations were made to improve the new product development process in the food and beverage industry to align with best practice. Finally, the potential of an integrated sensory framework was demonstrated as a key strategy that could be implemented to clearly translate customer needs into a standard descriptive language for use across the new product development process.

References:

Annachino, M.A. (2007), *The Pursuit of New Product Development: The Business Development Process*, Butterworth-Heinemann, UK.

Baker, M. and Hart, S. (2007), *Product Strategy and Management*, Prentice Hall, England, pp. 152-159.

Bernard, H.R. (2002), *Research Methods in Anthropology: Qualitative and Quantitative approaches*, 3rd Edition, Alta Mira Press, California.

Bizcommunity (2017), "Innovation, product diversification drives forecourt retail growth", available at: http://www.bizcommunity.com/Article/196/182/166390.html (Dated: 11 October 2017).

Civille, G.V. and Carr, B.T. (2015), *Sensory Evaluation Techniques*, 5th Edition, CRC Press, Florida, pp. 180.

Cooper, R.G., and Edgett, S.J. (1996), "Critical success factors for new financial services", *Marketing Management*, Vol.5, No.3, pp. 26-37.

Cpzaki, J. (1995), *Food Product Development*, Publishing House of the University of Agriculture, Poznan.

Crawford, C. M. (1972), "Strategies for new product development: Guidelines for a critical company problem", *Business Horizons*, Vol. 15, No. 6, pp. 49.

Cresswell, J.W., and Plano Clark, V.L. (2011), *Designing and Conducting Mixed Method Research*, 2nd Edition, Sage Publications, California.

Earle, M., Earle, R. and Anderson, A. (2001), *Food Product Development: Maximising Success*, Woodhead Publishing Limited, England.

GORTT (2017), "Review of the Economy 2017", The Government of The Republic of Trinidad and Tobago, available at: http://www.finance.gov.tt/wp-content/uploads/2017/10/Review-of-the-Economy-2017-for-web.pdf (Dated: 10 October 2017).

Investt (2017), "Manufacturing: Key Activities", InvesTT, available at: http://www.investt.co.tt/available-industries/manufacturing (Dated: 02 October 2017).

Kotler, P. and Keller, K. (2009), *Marketing Management*, 13th Edition, Pearson Education, New Jersey.

Lee, Y., and O'Connor, G. (2003), "New product launch strategy for network effects products", *Academy of Marketing Science*, Vol. 31, No. 3, pp. 241-255.

Motilal, C., Sankat, C.K. and Pun, K.F. (2014), "An open innovation paradigm model for the food and beverage industry in Trinidad and Tobago", *Proceedings of the Third Industrial Engineering and Management (IEM3-2014) Conference*, Faculty of Engineering, The University of the West Indies, St Augustine, Trinidad and Tobago, December, pp 53-59.

O'Sullivan, M. (2017), *Difference Methods: A Handbook for Sensory and Consumer-Driven New Product Development*, Woodhead Publishing Limited, UK, pp. 3-12.

Patton, M. Q. (2002), *Qualitative Research and Evaluation Methods*, 3rd Edition, Sage Publications, California, pp. 14.

Perreault, W.D. and McCarthy, J.E. (2006), *Essentials of Marketing: A Global Managerial Approach*, 10th Edition, McGraw-Hill/Irwin, New York.

Rudder, A., Ainsworth, P., and Holgate, D. (2001), "Case study: New food product development: strategies for success?" *British Food Journal*, Vol. 103, No. 9, pp. 657-670.

Schimmoeller, L.J. (2010), "Success factors of new product development processes", *Advances in Production Engineering and Management*, Vol. 5, No. 1, pp. 25-32.

Sensoryanalysis.com. (2015), "Descriptive Analysis | Services | Sensory Analysis Center | Kansas State University", available at: https://www.sensoryanalysis.com/services/descriptive-analysis (Dated: 12 April 2019).

Sosa, M.E., and Mihm, J. (2008), "Organisation design for new product development", In: Loch, C.H. and Kavadias, S. (Ed). *Handbook of New Product Development Management*, Elsevier Ltd, Oxford, UK, pp. 165-197.

Swift, K. (2014), *Four Innovative Companies in Trinidad and Tobago*, Council for Competitiveness and Innovation.

Thomke, S.H. (2007), *Managing Product and Service Development: Text and Cases*, McGraw-Hill/Irwin, New York.

Wright, J.N. and Race, P. (2005), *The Management of Service Operations*, 2nd Edition, Thomson, London.

Authors' Biographical Notes:

Satira Bajnath *is Managing Director of Indigenous Flavours Limited. She obtained her BSc. Chemistry (First Class) from The University of the West Indies and has acquired her MSc. Innovation, Manufacturing Management and Entrepreneurship at The University of Trinidad and Tobago. She has vast industry experience and related certifications including Quality Management, HACCP, Risk Analysis, Food Safety and Health and Safety.*

Umesh Persad *is an Associate Professor of Design and Manufacturing at The University of Trinidad and Tobago. He obtained his BSc. in Mechanical Engineering (First Class) from The University of the West Indies, and his Ph.D. from The University of Cambridge in Engineering Design, with a special focus on Inclusive Design.*

■