FINAL REPORT – PHASE II

Report on

‘Global landscape of Artificial Sweetener Industry’

Company Name: The Smart Cube

Submitted to:

Prof. Ashwini Awasthi

Submitted by:

Name: Nabarupa Sen

Roll No: 191433

Section: D

Batch: MBA – FT (2019-2021)

Institute of Management, Nirma University

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EXECUTIVE SUMMARY

The artificial sweetener market with market size of $6.35 billion is expected to exhibit a CAGR of 6.3% for the forecasting period of 2019-2025. Increasing disposable income, consumer health awareness will drive the growth in the market. APAC is the growing potential market with 52% market share due to increasing disposable income and health awareness. Sucralose has the highest market share by type due to its taste profile whereas Aspartame and Acesulfame-K are most traded sweeteners. Food and beverage industry have largest share in artificial sweetener application. Pharmaceuticals is another major industry for artificial sweeteners. According to the trade information, China is the largest leading exporter of artificial sweeteners globally. It exports 13% of the total export of organic chemicals by value. USA is the largest importer of artificial sweeteners. It is an intense competitive and fragmented market with homogeneous products and is high in innovation and development. China being the epicenter of the pandemic as well as the global manufacturing hub, it is difficult for the companies to procure raw materials and hence they are looking for alternative suppliers

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PART A: ABOUT THE COMPANY

The Smart Cube is a global professional services firm that specializes in delivering custom research and analytics services to corporations, financial services and management consulting firms. It was founded in 2003 and at present is headquartered in London, England (UK). It has its additional offices in The United States, China, Germany, Romania, Switzerland and India. The firm has conducted approximately 30,000 studies till date across virtually every major, industry, function and region through its global team of over 600 analysts.

The Smart Cube has been now recognized by major market leaders of Fortune 100 and retains 90% of its client annually. It strives for brewing analytically enriched and technology enabled solutions to its clients across the globe. It delivers business intelligence and helps its clients with smart and strategic decision making. This helps the clients to get competitive edge over others in the dynamic business environment. It has been awarded “Great place to work” by Great place to work Institution. It had tapped various sectors across globe and had grown to be one of the leading analytics consulting firm.

PART B: ABOUT THE PROJECT

Objective of the study:

- To study the global landscape of the artificial sweetener industry using the market overview, market segmentation and various market drivers and restraints
- To identify key potential suppliers in the industry and determine the supplier landscape along with the supply and value chain
- To study detailed trade information of the artificial sweetener and assess favourable trade locations
- To study the impact of COVID-19 on the dynamics of the artificial sweetener industry

Utility of the study:

The project was intended to give detailed information of the artificial sweetener industry helping the clients or the end users of the reports to make informed decisions in their respective areas of industrial applications of artificial industry.

Methodologies:

- The organisation assigned a secondary research project based under Consumer packaged goods on the global landscape of artificial sweetener industry. Both Qualitative and quantitative data were covered for the research.
- Information was collected using latest summary reports on artificial sweetener industry, consumer reports and blogs like Food Navigator and other sites. Trade information was captured from ITC trade map, UN Comtrade, and World Bank. News sites were also used to capture recent and relevant data which were helpful in data analysis.
- Since it was a purely second research project, there was no use of primary data resources and hence no sample data was collected. The information was purely from secondary sources.

Limitations:

Since the industry is fragmented, there are many local players which serve few clients. Hence complete database for those part of the industry couldn’t be accessed. This is one of the limitation of the project. Local players who contribute significantly to the company growth which are difficult to identify and hence there is some gap in overall data.

ABOUT THE INDUSTRY

The artificial sweetener industry is a fragmented market that contains many local players offering homogeneous products i.e. sweeteners. It provides raw materials to the consumer companies especially the food and beverage companies as well as retail table top sweeteners.

One major challenge that the industry face is immense competition from growing natural sweeteners like stevia, monk fruit syrup which are natural and are calorie free. The consumer's inclination towards natural products is increasing and has been aggravated in the current situation of public health crisis. The growing preference for organic and naturally derived ingredients and food products is hindering the growth of the industry.

The key pivot in the industry is constant innovation. For example, Aspartame continued to dominate the artificial sweetener market until the advent of sucralose in 90s which now holds the largest market share of artificial sweetener industry by type. The nature of the offerings demands the industry players to be constantly innovating and to have enhanced R&D capabilities.

Another major problem that the industry deals with is constant scrutiny of the safety of the sweeteners. Artificial sweeteners are synthesized chemicals which have different metabolic effects on human body on consumption. For example, aspartame breaks into its constituent amino acids phenylalanine which cannot be consumed by people with rare genetic disorder named *phenylketonuria* whereas acesulfame-K is not digested by the human body and hence have no harmful metabolic effects. There are researches that proves that some of the sweeteners can be carcinogens (sweeteners causing cancer) and the instability of the sweeteners at higher temperatures. These restricts the industry growth as the players have to follow various rules and guidelines in usage of such food chemicals.

COVID-19 has affected industries worldwide and artificial sweetener industry was no exception. The recent pandemic situation has created an array of disruptions in the demand and supply of artificial sweeteners. The companies are depending on their stock and inventory for their production and meet the surge in demand in this widespread lockdown period. The supply chain has been facing distribution and logistics bottlenecks. Quality assurance of the raw materials has been challenging in the present times

DATA REPRESENTATION

The scope of the project includes a detailed study of the artificial sweetener global market focusing on the supply and procurement side of the market and relate it with the current global scenario of disruptions and pandemic.

Market overview: The project was started with performing a market overview to have a brief understanding of the industry. It included defining artificial sweetener and various sweeteners were classified into natural and artificial sweeteners. There are many artificial sweeteners but only five of them have qualified for consumption by food and drug administration of the United States. These sweeteners have extensive application across consumer and packaged goods industry and is used as a substitute of sugar. This topic helped me to understand the value offered in the industry. A brief coverage on health aspects of these sweeteners was done as well. It was not included in the objective of the project but it helped to create a conceptual base on which further interpretation and analysis can be performed.

The market size was measured using revenue and projecting prospective growth in the forecasting period. Factors influencing growth were listed like rising diabetic population, increased health awareness, boost in packaged goods industry and many more.

YEAR	REVENUE(IN MILLION US$)
2014	19,093.50
2015	19,202.10
2016	18,958.10
2017	19,257.30
2018	19,437.20
2019	19,607.30
2020	19,958.10
2021	20,522.10
2022	21,169.90
2023	21,922.60
2024	22,575.10
2025	23,063.90

Figure 1: Revenue of artificial sweetener industry from year 2014 to year 2025F

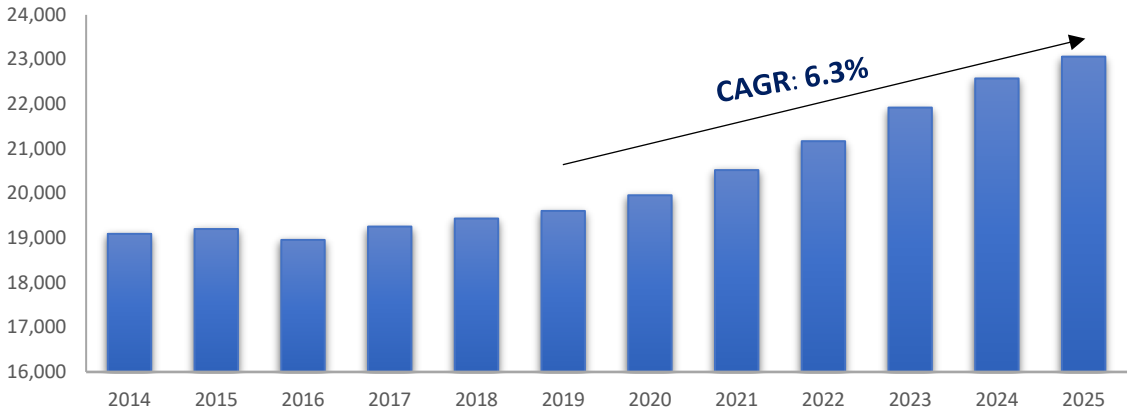

Figure 2: Projected revenue growth in period 2014-2025F

Market segmentation: The next topic covered was market segmentation. The industry was segmented on basis of three categories, type, geographical location and end-use application. Further market drivers and market restraints were identified. Numerous articles were covered to shortlist the factors and capsulate that information in projecting the market trends. For example, increasing consumer awareness is a market driver for artificial sweetener since people are getting more health and hygiene conscious whereas, improved lifestyle is more of a market trend. As a result, the information collected projected the value chain of the industry. Recent developments in the artificial sweetener industry were also extracted. For example, food and beverage being the largest industry using artificial sweeteners other than pharmaceuticals, cosmetics, confectionaries, had been dynamic. The health aspects on usage of such sweeteners have caused serious effect on these industries in reaction to which top firms are switching to natural sweeteners. Hence such industrial information is important for the client.

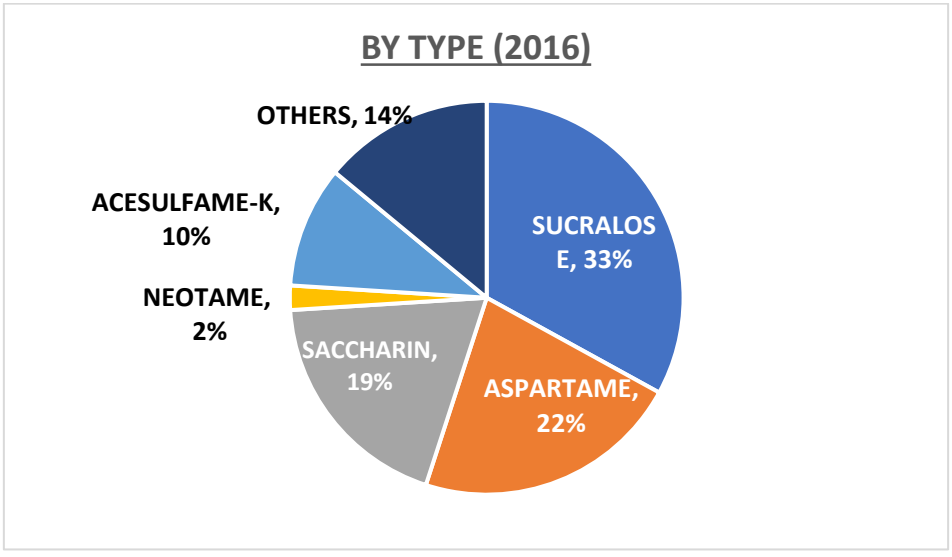

Figure 3: Market segmentation by type (2016)

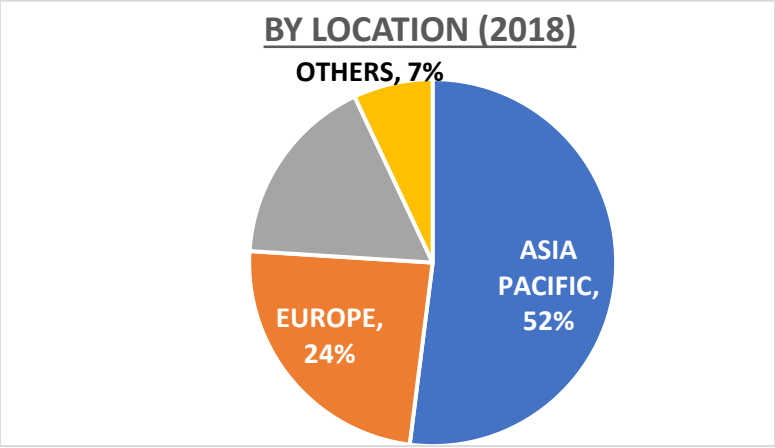

Figure 4Market segmentation by location (2018)

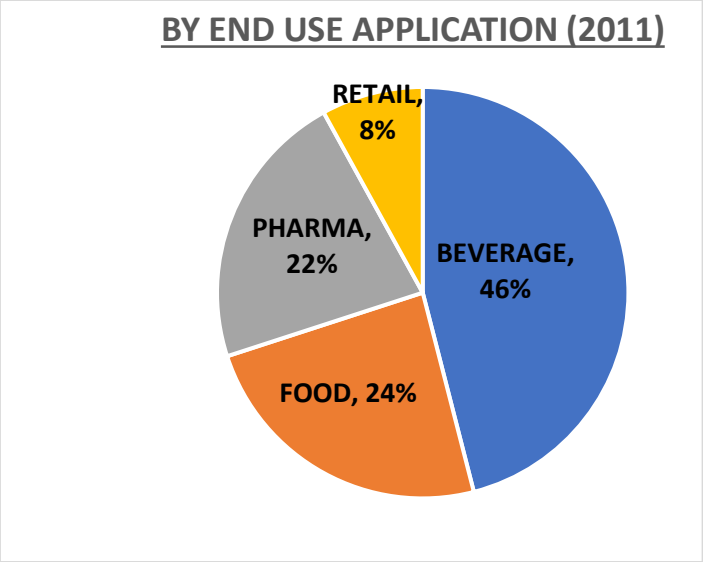

Figure 5Market Segmentation by application (2011)

ARTIFICIAL SWEETENERS	SWEETNESS IN COMPARISON TO SUGAR
Saccharin	200–700x
Aspartame	180–200x
Acesulfame-K(potassium)	200x
Neotame	7,000–13,000x
Sucralose	600x

Figure 6 Degree of sweetness of artificial sweeteners

Market drivers and restraints:

Drivers:

- Rising adoption of artificial sweeteners by F&B Companies to benefit from sugar taxes: Sugar taxes are the taxes, a regulatory measure used by the government to curb the consumption of sugar-added beverages that contributes to the rise of obesity. This will encourage manufacturers for reformulation and also generate revenue for public health initiatives. The response of large beverage companies like Coca Cola, PepsiCo were recorded to sugar tax. They reduced the bottle sizes and increased the prices whereas companies like sprite and 7Up reduced the sugar content in their product lines. UK, USA, Mexico, France were few of the countries with sugar tax
- Increasing population with increasing disposable income: Affordability and accessibility of packaged and canned goods has increased the market share for sweeteners. The increasing availability of low caloric food products has also accelerated the sugar substitute market.
- Rising health issues due to sugar consumption fueling the HIS market: Prolonged sugar consumption gives rise to various chronic diseases like diabetes, cardiovascular diseases etc. Sedentary lifestyles are aggravating the population health index and hence consumption of low caloric food products will be a new consumer trend
    - Energy imbalance between calories consumed and calories expended due to urbanisation and sedentary lifestyle with increased consumption of saturated fats is leading to obesity. According to an official study, India would be the world's diabetic capital by 2030

Restraints:

- Growing market of stevia: Introduction of stevia is a major restraint because of its non-caloric value and improved taste profile which is driving many consumers as well as manufacturers towards natural sweeteners. Moreover, the rise of novel infections has caused consumers to adopt natural products. Company are inclined to ensure utmost consumer satisfaction. In 2011, 2260 products were available with stevia extract as ingredient which rose to 6400 products in 2015
- Strict adherence to regulatory standards: Research have claimed few of the artificial sweeteners to be carcinogens- sweeteners causing cancer. Strict regulation for sugar substitute products and the uncertainty in its consumption given to carcinogenic nature of few sweeteners have created fear among consumers and has extremely affected consumer's purchase intent.

Market Trends:

Clean Labelling:

- The proliferation of clean label is driving the current market scenario of artificial sweetener. Clean labelling is making products with fewer ingredients that must be recognized by the consumers. This gives a strong affirmation to their purchase decision
- According to Thom King, president, and chief executive officer of Icon Foods, Portland, Ore., "The biggest consumer trend to impact the uses of sweeteners has been the demand for clean-label sugar reduction"
- On June 4, 2020, a petition was filed by the sugar association to FDA calling for complete and accurate labelling of low or no calorie sweeteners
- According to a recent consumer poll by Quadrant strategies, 66% of the respondents emphasized the importance of clear identification of sweeteners in food labelling

Constant role of taste in purchase intent :

- According to research , taste preferences mostly dominate over healthy choices in consumer purchase behaviour
- PepsiCo removed aspartame from Diet Pepsi in 2015, replacing it with sucralose, another HIS. Ironically, customer demand prompted PepsiCo to bring back the aspartame-sweetened version of the diet soda in 2016.

Increasing preference for sugar free products:

- "Increasingly health-conscious consumers are paying close attention to sugar and calorie content of their favourite food" claimed by Marketing leader of Ingredion EMEA
- According to the Mintel data, 64% of consumers of Europe, middle east and Africa, "low in calories" claim is important for buying their food and beverages

Trade information: In order to capture the global landscape of the industry, detailed trade information of the artificial sweeteners was collected and leading trading economies were identified.

Import and export data of each of the artificial sweeteners were gathered using *HS product codes*. The top 10 exporters and importers were compared to the global trade volume. Due to currency exchange, the analysis was done on basis of volume. Along with that, top 2 exporting destination were identified for top 4 exporting countries and same in the case of importing countries. Tariff corresponding to these trades was extracted and using this, most favourable markets were suggested. Countries imposing less tariffs on the exports would be favourable. This information would be crucial to the client since it would help the client in strategic sourcing and cost management. Further interpretations were made on the data and crucial trade points were analysed.

The following trade and tariff data were captured and important interpretations were made to determine the geographical focus of the industry.

Interpretations:

China was mapped out to be the largest exporter of all the four artificial sweeteners across the globe and the scale of the supply chain disruption could be measured in the current pandemic situation. USA is the largest importer of all the four artificial sweeteners listed.

Europe has also emerged to be one of the trade centres of artificial sweeteners Germany being the largest trader. European free trade agreement also makes it favourable for trade.

HS PRODUCT CLASSIFICATION	
CYCLIC AMIDES AND THEIR SALTS	292429
NUCLEIC ACIDS AND ITS SALTS	293499
SUCRALOSE	293214
SACCHARIN	292511

Figure 7: Product classification with HS Codes

HS Code: 292429 Product: Cyclic amides and their derivatives

Leading exporters (MT)									
YEAR	Global	China	Switzerland	USA	India	Japan	Germany	UK	Norway
2017	3,29,141	1,71,275	60,275	37,564	4,804	9,477	7,277	4,409	5,286
2018	3,01,109	1,53,631	60,268	27,912	5,603	9,620	7,740	5,671	5,445
2019	2,82,758	1,41,733	64,876	23,948	7,929	8,302	6,425	4,682	6,468
Share - 2019	100%	50.12%	22.94%	8.47%	2.80%	2.94%	2.27%	1.66%	2.28%

-Figure 8: Export trade information of Aspartame for period for 2017-2019

Leading importers (MT)									
YEAR	Global	USA	India	Argentina	France	Brazil	Indonesia	Ireland	Germany
2017	2,24,607	38,733	20,420	15,529	16,487	14,213	11,829	10,546	11,320
2018	2,72,626	44,351	22,544	14,334	14,966	17,908	11,651	9,945	12,442
2019	2,82,216	51,935	23,445	14,744	14,299	12,712	11,430	11,270	10,899
Share - 2019	100%	18.40%	8.31%	5.22%	5.07%	4.50%	4.05%	3.99%	3.86%

Figure 9: Import trade information of Aspartame for period for 2017-2019

Top exporting countries	Top exporting destinations (% of total exports by respective countries)		
	Name	%	Tariff
China	USA	19.28%	3.80%
	India	15.59%	7.50%
Switzerland	USA	47.51%	4.80%
	Brazil	19.71%	10%
USA	UK	20.99%	6.30%
	Belgium	6.91%	6.30%
India	Norway	34.12%	0%
	China	12.70%	7.50%

Top importing countries	Top suppliers (% of total exports by respective countries)		
	Name	%	Tariff
USA	Switzerland	64.07	6.50%
	China	22.43	6.50%
India	China	92.87	7.50%
	Germany	4.16	7.50%
Argentina	China	48.12	2%
	India	19.34	2%
France	Switzerland	29.77	0%
	USA	27	6.50%

Figure 10: Tariff among the top trading partners of Aspartame

HS Code: 293499 Product: Nucleic acids and their derivatives

Leading exporters (MT)									
YEAR	Global	China	Germany	USA	Japan	Switzerland	Netherlands	Belgium	UK
2017	2,81,733	90,147	38,997	19,170	11,483	10,063	11,837	12,079	10,600
2018	2,21,491	79,927	44,830	15,265	10,724	10,653	12,235	10,489	10,045
2019	2,36,122	78,900	49,508	13,446	11,829	9,203	12,320	12,495	9,198
Share - 2019	100%	33.41%	20.97%	5.69%	5.01%	3.90%	5.22%	5.29%	3.90%

Figure 11: Export information of Acesulfame-K for period 2017-2019

Leading importers (MT)									
YEAR	Global	USA	Belgium	Netherlands	China	India	Germany	France	Brazil
2017	2,72,007	12,537	35,547	12,089	10,813	12,095	12,332	10,137	10,137
2018	2,15,786	33,337	33,135	9,960	16,141	13,409	12,320	11,987	7,735
2019	2,72,877	31,372	28,100	20,405	19842	14,151	13575	14,864	12,501
Share - 2019	100%	11.50%	10.30%	7.48%	7.27%	5.19%	4.97%	5.45%	4.58%

Figure 12:Import information of Acesulfame-K for period 2017-2019

Top exporting countries	Top exporting destinations (% of total exports by respective countries)		
	Name	%	Tariff
China	India	26.17	6.38%
	USA	11.61	6.50%
Germany	USA	12.56	6.50%
	France	11.87	0%
USA	France	33.37	6.27%
	Germany	13.34	6.50%
Belgium	France	50.84	0%
	Germany	12.4	0%

Top importing countries	Top suppliers (% of total imports by respective countries)		
	Name	%	Tariff
USA	China	40.47	6.50%
	Belgium	24.57	6.50%
Belgium	Poland	33.4	0%
	USA	21.21	0%
Netherlands	Ireland	50.05	0%
	France	14.98	0%
China	India	39.63	6.50%
	Germany	15.61	6.50%

Figure 13: Tariff among top trading partners of Acesulfame-K

HS Code: 293214 Product: Sucralose

Leading exporters (MT)									
YEAR	Global	China	USA	Netherland	Germany	Ireland	Belgium	Eswatini	UK
2017	6,769	5,489	984	67	34	120	15	0	4
2018	8,561	5,393	2,328	318	149	142	21	17	47
2019	11,023	7,118	2,645	408	195	346	104	53	36
Share - 2019	100%	64.57%	24.00%	3.70%	1.77%	3.14%	0.94%	0.48%	0.33%

Figure 14: Export information of Sucralose for period 2017-2019

Leading importers (MT)									
YEAR	Global	USA	Netherlands	UK	Chile	Belgium	Brazil	Germany	Ireland
2017	2,688	1,185	131	296	285	121	292	45	50
2018	5,593	1,655	548	506	615	265	260	436	239
2019	9,121	2,684	690	790	682	430	361	348	297
Share - 2019	100%	29.43%	7.56%	8.66%	7.48%	4.71%	3.96%	3.82%	3.26%

Figure 15: Import information of Sucralose for period 2017-2019

Top exporting countries	Top exporting destinations (% of total exports by respective countries)		
	Name	%	Tariff
China	USA	38.45	3.70%
	Mexico	8.37	3.70%
USA	Netherlands	18.45	6.50%
	Mexico	14.37	6.50%
Netherlands	UK	28.43	0%
	Germany	17.16	0%
Germany	UK	27.17	0%
	Switzerland	9.23	0%

Top importing countries	Top suppliers (% of total imports of respective countries)		
	Name	%	Tariff
USA	China	100	3.70%
	Ireland	0	3.70%
UK	China	64.17	6.50%
	Netherlands	31.64	0%
Netherlands	China	55.65	6.50%
	USA	43.47	6.50%
Chile	China	62.9	0%
	Uruguay	29.76	0%

Figure 16: Tariff among top trading partners of Sucralose

HS Code: 292511 Product: Saccharin

Leading exporters (MT)									
Year	Global	China	Rep of Korea	Germany	India	Netherlands	Belgium	Spain	USA
2017	22,296	14,989	2,692	1,537	532	461	591	316	204
2018	21,000	14,484	2,201	1,483	624	411	334	234	157
2019	21,495	14,856	2,131	1,477	709	575	182	427	126
Share - 2019	100%	69.11%	9.91%	6.87%	3.30%	2.68%	0.85%	1.99%	0.59%

Figure 17: Export information of Saccharine for period 2017-2019

Leading importers (MT)									
YEAR	Global	Germany	USA	India	Brazil	Thailand	Spain	UK	Rep of Korea
2017	20,889	3,029	2,403	1,354	1,369	1,053	944	823	1,036
2018	18,303	2,261	2,156	1,128	721	1,007	1,197	924	815
2019	21,478	2,043	2,077	1,070	1,497	1,044	1,430	706	879
Share - 2019	100%	9.51%	9.67%	4.98%	6.97%	4.86%	6.66%	3.29%	4.09%

Figure 18: Import information of Sucralose for period 2017-2019

Top exporting countries	Top exporting destinations (% of total exports by respective countries)		
	Name	%	Tariff
China	Germany	15.09	6.50%
	Brazil	10.07	14%
Republic of Korea	USA	51.14	0%
	Mexico	11.54	0%
Germany	Poland	11.23	0%
	France	7.51	0%
India	USA	38.08	6.50%
	Switzerland	11.84	0%

Top importing countries	Top suppliers (% of total imports by respective countries)		
	Name	%	Tariff
USA	Rep of Korea	51.32	0%
	China	33.07	6.50%
Germany	China	81.59	6.50%
	Netherlands	6.21	0%
Brazil	China	98.2	14%
	India	1.6	14%
Spain	Germany	44.19	0%
	China	34.61	6.50%

Figure 19: Tariff among top trading partners of Saccharin

Supplier landscape:

It is crucial part of the project as it holds the main crux of it. In order to acquire relevant information about the topic, 20 – 25 suppliers were identified in the industry. These selected suppliers were profiled and were categorised under key potential and rejected suppliers. Profiling was done on essential parameters like application, geographical presence and contact details were provided for the potential suppliers which is relevant information for the client. It includes supply chain and value chain of the sweetener industry to recognize critical points of disruption.

The players were profiled capturing the information across selected parameters with their contact details specially for the client using the report.

Product portfolio:

- The product portfolio is a true indicator of the efficiency of a value chain. The extent of diversification in the product portfolio is critical for suppliers to have competitive edge over other key players
- Lower degree of product differentiation and higher availability of substitutes increases the competitiveness of the market hence customization of the products is essential
- The products are homogeneous in nature and hence must be differentiated on basis of taste profiles and reduced health risk

Economies of scale:

- The key suppliers are equipped with technological infrastructure and has a manpower ranging from 100 to 40,000
- Few of the suppliers have extended their production with mergers with other companies. For example, Tate & Lyle made a strategic alliance with McNeil Nutritionals for brand Splenda, HYET sweet and Vitasweet having same manufacturing centres

Innovation:

- Constant innovation is the core competency of this industry and most of the key suppliers have extensive facilities for research and development . Continuous research for safe and efficient artificial sweeteners has given rise to intellectual property trends
- The key suppliers compete on their R&D capabilities and degree of customer satisfaction. Tate & Lyle is known to have one of the most diversified research, application labs and constantly working on process innovation

- The key suppliers ensure their market share through patents. In 2014, NutraSweet stopped aspartame production as it was facing cut throat competition as a supplier due to the expiration of its patent. The company was taken under Mosanto who later on sold the retail face of aspartame, “Equal” to Merisant making the latter one of the largest suppliers of aspartame

Geographical presence:

- The suppliers have high geographical presence in Asia Pacific and North America which are identified to be the leading artificial sweetener market, hence market presence in these locations generates high competition
- Asia pacific is the growing market for sweetener since it has the largest diabetic population of the world
    - 8 of the 16 listed suppliers are China-based making China the largest source of artificial sweetener
    - Highest diabetic population is in China with around 116 million people suffering from it, hence driving the artificial sweetener market
- North America is the largest market for artificial sweeteners for reasons such as USA is the largest importer of artificial sweetener and increasing demand for dietary food and beverages.
- Europe is the growing market for sweeteners, Germany being the largest sweetener market. But the natural sweetener market have dominance over artificial sweeteners.
    - Cargill, Tate and Lyle are European market leaders in sweetener industry which manufacturers natural sweeteners on a large scale.

Further the identified suppliers were categorised as pure play and diversified players to give a clearer picture of the supplier landscape

- **Pure players:** The suppliers classified as pure play manufacturer only one line of product that is artificial sweeteners in the food industry. The pure play suppliers are China-based and are leading manufacturers though they operate in China only. Degree of innovation is comparatively less than that of diversified companies. Few of the pure plays also produce the raw materials for the product line like Hua Sweet.

- **Diversified players:** The suppliers under this categorisation manufacturer variety of products for various industries like pharmaceuticals, services etc. These players have global presence and tend to expand their operations through mergers and alliances. They have high innovation capabilities

Supplier	APAC	Africa	Europe	North America	South America	Middle east
ADM	✓	✓	✓	✓	✓	✗
AJINOMOTO	✓	✓	✓	✓	✓	✗
CELENESE	✓	✗	✓	✓	✓	✗
CUMBERLAND PACKAGING	✗	✗	✗	✓	✗	✗
HEARTLAND FOOD	✓	✓	✓	✓	✓	✓
JK SUCRALOSE	✓	✗	✓	✓	✗	✗
NUITANG	✓	✗	✓	✓	✓	✓
NUTRASWEET PROPERTY	✓	✗	✓	✓	✗	✗
HUASWEET	✓	✗	✓	✓	✗	✗
HYET SWEET	✓	✗	✓	✓	✗	✗
JMC CORPORATION	✓	✓	✓	✓	✓	✓
MERISANT	✓	✓	✓	✓	✓	✗
SINOSWEET	✓	✗	✓	✓	✗	✗
VITASWEET	✓	✓	✓	✓	✓	✓
ANHUI JINHE	✓	✗	✗	✗	✗	✗
TATE & LYLE	✓	✓	✓	✓	✓	✓

Figure 20: Geographical presence of identified suppliers

The table depicts the detailed geographical presence of the identified key suppliers

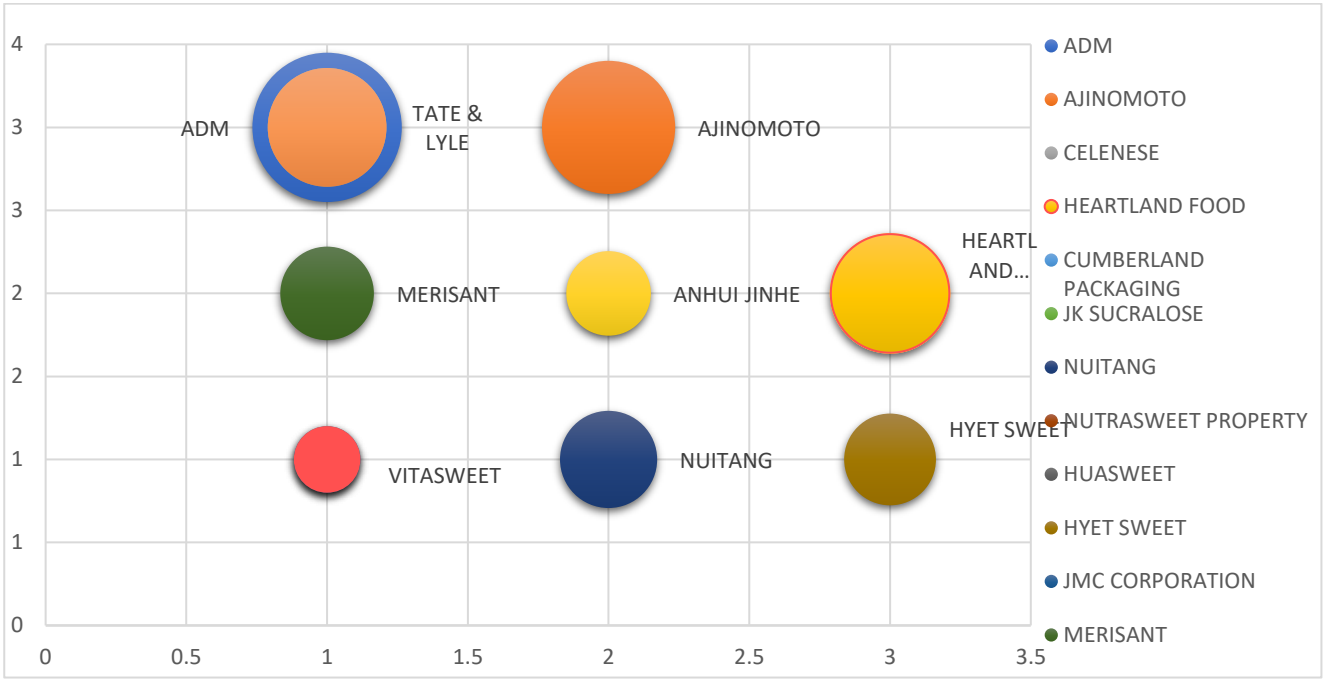

Figure 21: Graphical representation of suppliers landscape

The key potential suppliers were identified and were ranked using supplier ranking and were located in matrix of product portfolio and revenue ratings.

Rank[2]	Suppliers	Product Portfolio			No of Employees			Current Revenues			Innovation			Geographical Location			Overall Percentile Values as per Weights
		Ratings	Z Values	Percentile (based on Z table)	Ratings	Z Value	Percentile (based on Z table)	Ratings	Z Value	Percentile (based on Z table)	Ratings	Z Value	Percentile (based on Z table)	Ratings	Z Value	Percentile (based on Z table)	
1	AJINOMOTO	2	0.47	0.68	3	1.98	0.98	3	1.46	0.93	3	1.42	0.92	3	0.68	0.75	83%
2	ADM	1	-0.78	0.22	3	1.98	0.98	3	1.46	0.93	3	1.42	0.92	3	0.68	0.75	74%
3	TATE & LYLE	1	-0.78	0.22	2	0.60	0.73	3	1.46	0.93	3	1.42	0.92	3	0.68	0.75	70%
4	HERATLAND FOOD	3	1.71	0.96	2	0.60	0.73	2	0.29	0.61	1	-0.97	0.16	3	0.68	0.75	67%
5	CELENESE	1	-0.78	0.22	2	0.60	0.73	3	1.46	0.93	2	0.22	0.59	3	0.68	0.75	65%
6	NUITANG	2	0.47	0.68	2	0.60	0.73	1	-0.88	0.19	1	-0.97	0.16	3	0.68	0.75	53%
7	MERISANT	1	-0.78	0.22	1	-0.77	0.22	2	0.29	0.61	2	0.22	0.59	3	0.68	0.75	51%
8	HYET SWEET	3	1.71	0.96	1	-0.77	0.22	1	-0.88	0.19	1	-0.97	0.16	3	0.68	0.75	51%
9	ANHUI JINHE	2	0.47	0.68	2	0.60	0.73	2	0.29	0.61	2	0.22	0.59	1	-2.05	0.02	46%
10	NUTRASWEET PROPERTY	2	0.47	0.68	1	-0.77	0.22	2	0.29	0.61	2	0.22	0.59	2	-0.68	0.25	45%
11	VITASWEET	1	-0.78	0.22	1	-0.77	0.22	1	-0.88	0.19	2	0.22	0.59	3	0.68	0.75	43%
12	JMC CORPORATION	1	-0.78	0.22	1	-0.77	0.22	1	-0.88	0.19	1	-0.97	0.16	3	0.68	0.75	36%
13	JK SUCRALOSE	1	-0.78	0.22	1	-0.77	0.22	1	-0.88	0.19	3	1.42	0.92	2	-0.68	0.25	33%
14	CUMBERLAND PACKAGING	3	1.71	0.96	1	-0.77	0.22	1	-0.88	0.19	1	-0.97	0.16	1	-2.05	0.02	29%
15	HUASWEET	1	-0.78	0.22	1	-0.77	0.22	1	-0.88	0.19	1	-0.97	0.16	2	-0.68	0.25	21%
15	SINOSWEET	1	-0.78	0.22	1	-0.77	0.22	1	-0.88	0.19	1	-0.97	0.16	2	-0.68	0.25	21%

Table: Supplier Ranking

Supply Chain: The supply chain and the value chain were captured starting from procurement of raw materials to end-use products.

Procurement of raw materials:

- Quality of the raw materials is ensured through numerous supplier and food defence audits
- Mutual cooperation and collaborative relationship between the suppliers and company is vital for rigorous quality assurance and sustainable procurement
- For example, Ajinomoto performs surveys across 500 suppliers approx. and interviews suppliers according to the results of the survey ensuring compliance with its quality standards

Manufacturing processes:

- Physical conditions like temperature, pressure must be maintained in the manufacturing process of artificial sweetener
- Storing conditions and facilities are different depending upon the chemical properties of sweeteners. For example, aspartame can be stored between a temperature range of 4- 21 degree Celsius whereas aspartame has tremendous stability in solid form in high temperature
- Inspection and checks are carried out throughout the manufacturing process to avoid intentional product tampering or system failures

Finished Products:

- Finished products are distributed in form of raw materials for food and beverage, pharmaceutical industry as well as end-use products to retailers
- Companies provides quality related information such as the method of storing, product usage warnings, etc on product packages
- In 2017, Ajinomoto faced huge quality disruption due to human error such as misprint of best before use which accounted for almost half of quality related incidents

Distribution:

- The top suppliers have alliances to make the supply chain efficient and sustainable.
- For example, Tate &Lyle has oracle transportation management cloud for efficient supply chain.
- According to recent news, manufacturers will be adjusting their plants post COVID-19 to reduce disruption in the supply chain

End use consumers:

- The products manufactured are used directly as table top sweeteners and used indirectly through food products and medicines
- Customer inquiries are analysed and are communicated to the product development division
- Companies are providing platforms where customers can convey their feedback and complaints can be addressed

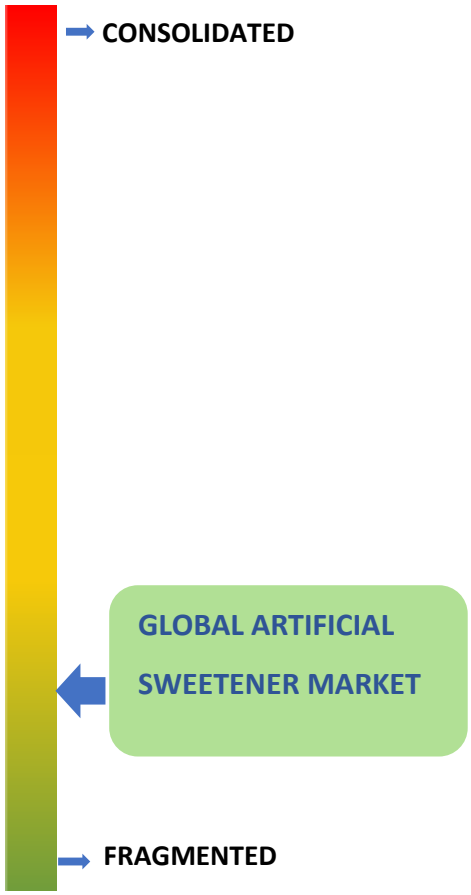

Figure 22: Pictorial representation of nature of artificial sweetener market

The following tables is the supplier profiling used to derive the relevant interpretations to determine the supplier landscape by verifying information from respective supplier websites

#	Supplier	Sweeteners portfolio					Application Areas			Production Capacity (Metric Tons/year)	Export Capabilities/ Sales Presence	Production/ Processing Location	Quality Certificates	Revenue ($ million)	Corresponding Year for revenue	Headcount	Contact Details		
		Saccharin	Aspartame	Acesulfame-K	Sucralose	Neotame	Beverages	Bakery	Pharmaceuticals								Address	Phone	Email Address
1	Archer Daniels Midland	–	–	–	Yes	–	Yes	Yes	Yes	–	Africa APAC Europe Americas	USA (160) China Europe	GMP PEFC ISO 9001:2015	64,340	2019	38,100	77 West Wacker Drive, Suite 4600, Chicago, Illinois 60601, United States	321-634-8100	Contact form
2	Ajinomoto	–	Yes	–	Yes	–	Yes	–	Yes	–	Africa APAC Europe Americas	Japan USA Thailand South America	ASQUA (Based on ISO 9001,HACCP, GMP)	10,200	2019	34,504	15-1 Kyobashi 1-chrome, Chuo-ku, Tokyo, 1040031, Japan	81 -35250- 8111	info@ajinomoto.com
3	Celanese	–	–	Yes	–	–	Yes	Yes	Yes	–	APAC Europe Americas	North America China Germany Sweden Netherlands	FSSC 22.000 ISO9001:2008 DIN EN ISO 14001:2008 HACCP	6,140	2018	7,592	222 W. Las Coli–s Blvd., Suite 900N, Irving, Texas, 75039, United States	01972-443-4000	Contact form
4	Cumberland Packaging	Yes	Yes	Yes	–	–	Yes	Yes	–	–	USA	USA	Non -GMO USDA Organic Certified	100	2018	436	2 Cumberland street, Brookyln, New York, 11205, United States	718- 858-4200	Contact Form
5	Heartland Food Products	Yes	Yes	–	Yes	–	Yes	Yes	–	–	North America Europe Middle east Africa Latin America APAC	Indiana Mexico Netherlands	Certified SQF Quality Supplier Organic certified Kosher Certified Halal Certiffed	1,950	2018	1,200	4925 W. 86th Street, Suite 129, India–polis, India– 46268, United States	317-708-2963	Contact Form

Figure 23: Supplier profiling 1

#	Supplier	Sweeterners portfolio					Application Areas			Production Capacity (Metric Tons/year)	Export Capabilities/ Sales Presence	Production/ Processing Location	Quality Certificates	Revenue ($ million)	Corresponding Year for revenue	Headcount	Contact Details		
		Saccharin	Aspartame	Acesulfame-K	Sucralose	Neotame	Beverages	Bakery	Pharmaceuticals								Address	Phone	Email Address
6	JK Sucralose	–	–	–	Yes	–	Yes	Yes	Yes		APAC Europe North America	China	GMP ISO22000: 2005 ISO14001: 2015 FSSC22000 v4.1 OHSAS18001: 2007	12	2018	60	118 Renmin East road, Sheyang County, Jiangsu-224300, China	515- 8217-8898	jk@jksucralose.com
7	Nuitang	–	Yes	–	Yes	–	Yes	Yes	Yes	1500	Americas China Europe Middle east South east asia Australia	China	FSSC22000 ISO9001 ISO14001 Kosher Certified Halal Certified	–	–	1,400	Room 1708 Changfa Building No.5, Yanzhen Road, Wujin, Changzhou, Jiangsu Province, 213161, China	519-682-12338	Contact Form
8	Nutrasweet Property Holdings	–	–	–	–	Yes	Yes	Yes	–	–	USA APAC Europe	USA	GMP	123	2019	417	222 Merchandise Mart Plz Ste 936, Chicago, IL, 60654-1101 United States	312-873-5000	Contact Form
9	Huasweet	–	Yes	–	–	Yes	Yes	Yes	–	1000	Europe USA Japan India	China	FSSC22000 ISO9001 ISO14001 Kosher Certified Halal Certified OHSAS 18001	2.5	2017	–	North Avenue of Chuangye Road, Gedian Economic Development Zone, Hubei, 436070, China	8627-593-70808	sales@huasweet.com
10	HYET sweet S.A.S	–	Yes	Yes	Yes	–	Yes	Yes	Yes	10,000	Europe Asia USA	China	HACCP GMP BRC HALAL certified Kosher Certifited	–	–	74	No 198, Jinwu Road, Liyang, Jiangsu, 213300,China	946-845-7334	info@hyetsweet.com

Figure 24: Supplier profiling 2

#	Supplier	Sweeterners portfolio					Application Areas			Production Capacity (Metric Tons/year)	Export Capabilities/ Sales Presence	Production/ Processing Location	Quality Certificates	Revenue ($ million)	Corresponding Year for revenue	Headcount	Contact Details		
		Saccharin	Aspartame	Acesulfame-K	Sucralose	Neotame	Beverages	Bakery	Pharmaceuticals								Address	Phone	Email Address
11	JMC Corporation	Yes	–	–	–	–	Yes	Yes	Yes	–	Europe Middle East Asia Australia Africa America	South Korea	FSSC 22000 ISO 9001 ISO 14001 OHSAS 18001 Kosher Halal	–	–	203	71, Ijin-Ro, Onsan-Eup, Ulju- Gun, Ulsan, 44998, South Korea	52-231-5755	jmc@jmcmail.co.kr
12	Merisant	–	Yes	–	–	–	Yes	Yes	Yes	–	Africa Asia Europe North America	Manteno Teplice Czech republic	OHSAS 18000 ISO 9000:2000 Voluntary Protection Program	117	2018	418	125 S Wacker Dr Ste 3150, Chicago, IL, 60606-4414 United States	312- 840-6000	Contact Form
13	Sinosweet	–	Yes	–	–	–	Yes	Yes	–	12,000	USA China Argenti– Ireland South Korea Japan	China	ISO 9001: 2008 ISO 14001 FSSC 22000 Halal certified	–	–	500	Yangzhu, Dapu Township, Yixing City, Jiangsu Province, 214226, China	510-874-54210	Contact form
14	Vitasweet	–	Yes	Yes	–	–	Yes	Yes	Yes	–	Europe Americas Middle East Africa Asia Australia	China (3)	ISO9001 ISO14001 ISO22000 RQA BRC Halal	–	–	800	No 198, Jinwu Road, Liyang, Jiangsu, 213300,China	86-1084-871211	Contact form
15	Anhui JinHe Industrial	–	–	Yes	Yes	–	Yes	Yes	Yes	–	Asia	China (2)	ISO 9001 ISO 14001 Kosher Halal	595	2019	3,517	No. 127, East Street, Lai'an county, Anhui Province, 239200, China	0550-562-4224	ajhchem@ajhchem.com
16	Tate & Lyle	–	–	–	Yes	–	Yes	Yes	–	2,000	Middle East Africa Asia Americas	UK	BRC FSSC 2000 GMP	2,750	2019	4,162	1 Kingsway, London, WC2B 6AT, United Kingdom	044-2072572100	Contact form

Figure 25: Supplier profiling 3

Impact of COVID-19

Demand Fluctuations:

The need for good physical and mental health as been higher than ever, globally people are adopting healthier food habits and paying keen attention to ingredients. Functional ingredients and plant-based alternatives are perceived to be healthier alternative with rising consumer insecurities in this public health crisis

- Few articles have claimed that in UK, 78% of coronavirus infections and 68% of the COVID -19 deaths were obese
- 12% of organic food sales recorded are from beverages in May 2020

Due to economic suffering, consumers are becoming price sensitive, hence for lower income section, sugar free products may remain to be luxury products

For upper sections of people, cooking has emerged as a isolation coping activity.

- With food being prepared from scratch, demand for food ingredients have surged in this pandemic period.
- Widespread lockdowns which led to spike in demand of canned and processed foods, nutritional supplements with higher shelf life, etc

Supply Chain:

- **Reduction of full capacity production:** Due to the movement restriction, economic uncertainties, tightening credit market and many other factors are preventing firms to operate at full production. Operational disruptions had been inevitable amidst this pandemic with demand fluctuation, procurement issues and many more
- **Health of the workforce:** The industry may be especially vulnerable given that the bulk of its production the workforce is in on-site jobs that cannot be done remotely. Additionally, given the nature of the industry, companies may need to consider how to create social distancing in workplaces that are often worker-dense
- **Crisis management:** The present business continuity plan for typical contingencies like cyber incidents, natural disasters companies may be functional for a short time but may not address rapid moving and unknown variables of an outbreak like COVID-19. Most of the companies are depending on their inventory and have not faced any significant impact
- China being the global supplier for most of the raw materials as well as the epicentre of the pandemic, the disruptions caused has a bullwhip effect on the industry.

- Coco Cola declared in its annual reports that it has been observing tight supply of sucralose from China restraining the production of diet coke or zero sugar drinks
- Major suppliers are looking for alternative suppliers for procurement of raw materials perhaps replacing the Chinese suppliers

Quality Maintenance:

- FDA has advised that amidst this pandemic, good manufacturing practices like cleanliness and sanitation must be prioritized by the manufacturers
- Companies must ensure proper safety and precautionary practices in the operating workplace to mitigate the risk of spreading of the infection
- FSSAI approved private and public labs mandated for food testing has been observing hindrance in their operations

Consumer behaviour:

- "Connected customers" megatrend has emerged in this pandemic where digitalisation has become an imperative part of life. This has compelled the companies to restructure their channels of distribution supported with technological systems.
- The purchase behaviour of middle-class consumers has taken a significant shift from frugality to necessity. Consumers are judiciously utilizing the available resources and hence reducing waste. This has led to new business innovations based on resale and upcycling
- Consumption habits have increased. According to a survey by IFIC*, more than 40% of the consumers under the age of 35 are snacking more due to the lockdown period.

Impact on Pharmaceuticals:

- The demand has taken a high surge in the pharmaceutical industry due to the health crisis. For example, sweetening solutions are used to test the fit and level of protection of the face mask in order to provide reassurance to frontline workers
- The impact on pharma supply chain persists but the storage and inventory of raw materials will not disrupt the production for a few months
- China being the largest producer of pharmaceutical ingredients makes the supply chain more susceptible to disruptions in pharma industries for high importing nations like India
- China being in the recovery stage, manufacturing factories are reopening and ramping their production in addition with de-clogging and re-opening of logistics supply chain

Analysis: The artificial sweetener industry falls into the category of fragmented market. Fragmented market is a highly competitive space with no entry barriers for the new players. Hence, the bargaining power of suppliers would be low. The market can be considered to face severe competition from its substitute market of stevia and other natural sweeteners.

- The market will grow at a slower pace due to the competition from natural sweeteners
- F&B industry will continue to grow and innovate healthier options which will eventually create market scope for the artificial sweetener industry
- Recent pandemic situation and economic distress, especially strained economic relations with China has cause huge disruptions in global trade from procurement of raw materials due to factory shutdowns
- Requirement of good quality certification has been intensified in this pandemic situation. Clean practices are ensured as a precautionary standard for distribution of raw materials as well as final products
- Clean labelling is one of the growing trends in artificial sweetener industry due to constant safety speculations of the artificial sweeteners. It is one of the growing trends in the industry which may affect the consumer behaviour towards artificial sweeteners used as ingredients
- The companies are currently operating on their existing inventory and quickly adapting to the "new normal" due to COVID-19. Companies are adapting to digitization of business processes by conducting business and maintaining supplier relationship through online platforms.

Suggestions to CPG companies:

- Recent market trends like clean labelling, consumer health awareness will continue to grow in the artificial sweetener market. The pandemic situation had augmented these trends hence the companies must be able to integrate these trends with their value chain
- Inclination of consumers towards natural sweeteners and natural ingredients have a negative impact on the growth of the industry hence most of the companies are producing stevia including market leaders like Coca Cola. Hence the companies must track the customer preferences and changes in the value offerings of the industry
- Companies are opting for alternate suppliers since most of the suppliers are China-based. Local suppliers can be preferred in order to avoid logistics and procurement bottlenecks

LEARNINGS

The internship project had captured various aspects of an industry. There was a learning curve in dealing with data extraction, analysing the pool of data collected and extract relevant outcomings for the client or the concerned at the end use of the research. The virtual mode of internship had its pros and cons.

- The organisation had maintained a professional environment related to work. Progress of the project is tracked by the mentor on daily basis. Frequent meetings with HR ensures my mental and physical being and the challenges if any that I face from work from home. They had seamlessly created a corporate and professional experience as per their organisational culture which had helped me to have a sense of corporate culture and norms. In order to keep us motivated, virtual fun sessions with the head of the project team is organised and experiences are shared by the team on how this new normal of work from home had been treating them and the impact it had on their work.

- In respect to work, there had been a systematic approach in creating strong understanding of the industry. I have been able to develop new soft skills to uplift my work and received feedback on formatting and structuring of a report in a professional manner. I have learned how to evaluate an industry and what parameters must be considered for the same. ‘

- Effective presentation is highly essential for bringing quality and value to the work. Long term project requires such crisp and strong presentation skill in order to deliver more with restrained space and time. There must be specificity and flow in the slides and the information collected. I have learned to capture valuable data rather than the general information mainly filtering data relevant to the client requirements.

- It had been a continuous learning process to manage all the changes in the surrounding and maintaining the flow of work. Time management is one of the most important learning because recent times have shown the value of physical and mental health as well. The experience of work from home had provided me with sense of evaluating the disruptions that happen in any work environment.

- The concepts of organisational behaviour that were covered were actually helpful in understanding the experience. The value of motivation in the workforce, managing and working under superiors with different leadership style and many more behavioural nuances.

- Academic learnings were also useful in the internship project. Data analytic tools like normal curve, z score were used to rank the suppliers on parameters decided. Continuous feedback helped to understand the quality and relevance of the data captured and filter unnecessary information that any seem to be informative but contributes nothings towards achieving the objective.

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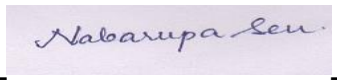
UNDERTAKING

To Whom It May Concern:

I, Nabarupa Sen, hereby declare that this assignment is my original work and is not copied from anyone / anywhere. If found similar to other sources, I shall take complete responsibility of the action, taken thereof by, Prof. Ashwini Awasthi.

Signature : 

Name : Nabarupa Sen

Roll No. : 191433

Section : D

Batch : MBA – FT (2019-2021)

Date : 5th July, 2020