SUSTAINABLE SUPPLY POLICIES FOR OPTIMIZATION OF CONTRIBUTION MARGINS IN FOODSERVICE AND NUTRITION CHILEAN: A CASE STUDY

Rojas, Fernando
Escuela de Nutrición y Dietética
Facultad de Farmacia, Universidad de Valparaíso,
Valparaíso, Chile
fernando.rojas@uv.cl

Pincheira, Daniela
Escuela de Nutrición y Dietética
Facultad de Farmacia, Universidad de Valparaíso,
Valparaíso, Chile
daniela.pincheira.r@gmail.com

Reception Date: 07/29/15 - Approval Date: 08/17/15

ABSTRACT

This case study highlights the importance of operations management in the area of, supplies of food service companies and Chilean nutrition.

It was proposed as a way to establish and evaluate financial policies for the supply of raw materials in the industry, to verify that they can be a source of sustainable competitive advantage. The work was carried out through the application of optimization models contribution margins of these companies, minimizing costs to purchase, store and sort. The models consider the characteristics of the components that make up the menus or to sue for end users of the service products as well as the behavior of the demand rates of the components independently. A recollection of actual data was performed for 27 weeks, in order to estimate the savings produced by the supply policy, and then a projected 5 years of operation was to finally quantify the investment required to carry out the policy and substantiate their sustainability with internal rate of return of 13%.

KEYWORDS: Supply; Food and Nutrition Services; Contribution Margins; Features Components; Financial Evaluation.

INTRODUCTION

Food services and nutrition (SAN) prepared on a daily basis a menu of foods or food dish based on raw materials. The final product produced and sold on the SAN is the menu and components or raw materials inventory assortment are being sued and supplied. The menus provided by the SAN are intended for groups of people in enclosed spaces such as schools, hospitals, institutions and universities regimes. Therefore, the menus are standardized and de fi ned under technical considerations. Most Chileans SAN belong to the small and medium enterprises (SMEs) and their contribution margins between 25% and 40% of its sales, according to the socioeconomic status of underserved groups. Rojas et al. (2015) state that the use of models of supply in SAN optimizes its contribution margins; however, it has not assessed the financial viability of the use of these models. This makes hypothesize that the use of procurement policies in SAN would be economically viable and financially.

El presente artículo propone una forma de establecer y evaluar financieramente políticas para el abastecimiento de las materias primas en el sector de SAN. El uso de políticas de abastecimiento en el área puede ser una fuente de ventaja competitiva sostenible para el sector. El trabajo se encuentra dirigido a profesionales del área de operaciones y abastecimiento de los SAN, así como a la comunidad académica que realiza investigación de operaciones.

DEVELOPMENT

Is it possible to generate a sustainable competitive advantage, based on improved supply industry SAN? They are replicable in these services, the handling of this part of the supply chain that have been successful in other industries? This case study assigned models related to raw materials used in SAN supply, minimizing the amount of materials to order, as well as storage costs and to order in a given time horizon, measuring the positive and sustainable impact of contribution margins of a typical company in this field, through a financial assessment.

The literature regarding the supply of this industry, it is very extensive and confined mostly to the world of hotel, catering and tourism, but not directly in the area of SAN, which have shown tremendous growth in developing countries such as Chile. There is empirical evidence about several cases of companies in the aforementioned sectors, as well as other related marketing services and in the area of manufactured products, which have shown development of strategies for successful supply. Researching about this competitive advantage generated is supported by improvements in water supply systems, are various models of strong statistical base model from heterogeneous views the problem of procurement of materials, such a policy is achieved to minimize the costs associated with purchasing, storage, generation of purchase orders and avoid shortages, etc. These models can be classified as deterministic or stochastic, depending on the behavior of the variability in rates of demand for materials. Moreover, according to the relationship between the components that make up the mix of materials and as the demand occurs, they can be independent or correlated demand. Finally, there are models that cost optimization focuses on adapting the way they operate according to the characteristics of perishability of the material in question.

In the case of SAN, considering the above features maintain that it is possible to find optimized contribution margins, to achieve by using models that take into account supply jointly premium rates to supply materials, the behavior of rates demand, which in turn are determined by the relationship between the defendants and their ingredients menus.

In Chile, the SAN are considered small and medium enterprises (SMEs) (Alarcon & Stumpo, 2000). These services are designed to develop and / or distribute food preparations according to sanitary and technical specifications, as well as national and international nutritional recommendations. Usually, these preparations are directed to inpatients and outpatients, but may also be administered to healthy users and consumers in general (Marambio, Parker & Benavides, 2005). The increase in the number of such services has been significant, generating an important source of employment in the country and providing multiple market opportunities. This is due to the need to feed people out of their homes, and the difficulty of moving from where they carry out their activities, such as companies, factories, public hospitals and private schools and universities. Due to the diversity of services, the complexity of the food industry has increased considerably, making it require a more professional management and regulation by government agencies (MINSAL, 2004).

In Table 1, representative contribution margins of industry, the most commonly worked services shown in Chile.

Table Nº 1: Contribution margins representative industry Food and Nutrition Services in Chile

Service	Price (USD)	Cost (USD)	Margin (USD)	Margin (%)	Variation (%)
Breakfast	2,4	1,2	1,2	50	+- 10
Packed	3,6	1,7	1,9	53	+-20
Sandwiches	3	1,3 3	1,67	55 ,6	+- 5
Desserts	3	1,5	1,5	50	+- 5

Source: Zaldaña & María (2011)

"Visión de Futuro" Año 13, Volumen Nº 20, Nº 1, Enero - Junio 2016 – Pág. 141 - 163
URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

Regarding the possibility of improving these figures may raise value-generating strategies in companies, which will result in primary activities and support, upon which sustainable competitive advantages are sustained over time, generating abnormal returns for companies that position its strategy according to the empowerment of little imitated strengths in any of these activities (Porter, 1996). You can be found in inbound logistics and supply, key activities, primary and support respectively, common to the supply of services features, which have worked in a good way to maintain competitiveness in other sectors, and therefore it is worth understanding whether these be replicated in these services (De La Fuente & Muñoz, 2003).

Here we review the literature regarding the main issues to consider for the posing of possible models of supply in SAN.

Supply Models

Supply systems minimize the total cost of inventory management, which are based on the variable and direct purchasing costs, and indirect costs of ordering and storing a lot purchase (Blankley, Khouja & Wiggins, 2008).

It is possible to conceive of the process of production SAN, as a module where the final product (a dish prepared) can be assembled from standardized components (raw materials), which are required on the basis of compliance with technical specifications, generating a minute , or order of assembly. Such a system approach presents an operational challenge, because each order of assembly involves various components in different quantities, then the shortage of any component can cause a delay in the execution of the order. Therefore, the optimum stock of one component to be determined in relation to other components, in order to ensure simultaneous availability (Agrawal & Cohen, 2001).

Among the authors who use a continuous time frame, highlight Gallien & Wein (2001), who take delivery of components in an assembly system for synchronized single product, i.e. the components are assembled in the same sequence in which they ask. Lu & Song (2005) studied the demand for components in a multi-system, assuming there is a cost rate associated with back orders, and they made a model of unconstrained optimization to minimize waiting. For his part, Wang (1999) considers a multivariate model of the demand components, but with a supply process capable of compliance for each component. Applying the asymptotic results developed by Glasserman & Wang (1998), analyzes the problem of minimizing the average cost of inventories subject to a speed restriction refueling. Lu et al (2005), Appears to be the first to optimize

"Visión de Futuro" Año 13, Volumen Nº 20, Nº 1, Enero - Junio 2016 – Pág. 141 - 163
URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

multiproduct batch With demand backlog. We refer the reader to Song & Zipkin (2003) for a more detailed state of the art research on component assembly systems study.

In all of the above approaches, the authors have worked with alleged distribution demands components. Note that demand for the amounts of components in a system such as the face, can not be provided exactly by multiple factors, making a random variable, then the variance is greater than zero. Fortunately, the behavior of such variables can be adequately described by a probability distribution (Rojas, Leiva, Wanke & Marchant, 2014). Generally the Gaussian (or normal) distribution has been used to describe the behavior of demand data products and components (Silver & Peterson, 1985). However, in many cases, the normal distribution may be inadequate to describe the behavior of these data, making it highly relevant to find the model that best fits the application, using methods goodness of fit. (Castro-Kuriss et al., 2010).

In the conceptualization Undertaken For This case, you May Have demand forecasting data component assembly system obtainable from the production planning delivered to the minutes, Considering forecast for random or stochastic Demands of These raw materials. The previous study assigns supply models for these components independently, minimizing the amount of raw materials ordering, storage costs and order inventory in a given time horizon, and evaluate the implementation of this policy through a technical feasibility study of investments and cost required by a financial evaluation (Sapag, 2003).

METHODOLOGY

Registration requirements of raw materials for minutes

Present the following information is recorded on a daily anonymous minute of food preparations of a SAN Chile:

- Assigning a coding daily minutes of food preparation (order of assembly) for 6 months: Mj, where the days of the minutes were identified in preparation for the $j=1,\ldots,180$. the type of power headed by type of public (normal, chronically ill, enteral, etc.) is also encoded as p = a,…,z. then we can encode minutes, like Mj,p

- Consumption rate components: Understand statistical quantities hope to use or consume daily for component i ($E(Q_i)$), according to the probability distribution of this variable, as the rate of daily consumption or daily demand component i $,\ldots,q$, to which we will call λi. So

$$\lambda i = E(Qi) \qquad (1).$$

"Visión de Futuro" Año 13, Volumen Nº 20, Nº 1, Enero - Junio 2016 – Pág. 141 - 163
URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

- Variability in the rate of consumption or demand component i: Which will be defined by descriptive statistics to consider the value of DS λi (σi)

Determination of financial indicators in minutes and component costs

Revenue generated by the sale of the types of daily minutes (Mj,p), They were obtained from the expression

$$I_{j,p} = P_{j,p} \times QV_{j,p}, \quad j = 1, \ldots, 180, \qquad (2)$$

where $I_{j,p}$ It is the income on the day j to the minutes coded Mj,p, $P_{j,p}$ is the price of type minuta p the day j, and $QV_{j,p}$ is the amount of type list p sold on j.

The costs of sourcing i required by the type of daily minuta (Mj,p), They were obtained by applying the expression

$$C_{i,j} = CN_{i,j} \times QA_{i,j}, \ i = 1, \ldots, p, \ j = 1, \ldots, 180, \qquad (3)$$

where $C_{i,j}$ for the cost of buying the component i the day j, $CN_{i,j}$ It is the net cost of the component i the day j, y $QA_{i,j}$ It corresponds to the quantity supplied (actual data), or to supply to its full potential as a solution to the problem.

The costs of storing components required by the type i daily minuta (Mj, p), were obtained by applying the expression

$$CA_{i,j} = \left(\sum_{k=1}^{5} CAD_{i,}\right) / R_{i,j}, \ i = 1, \ldots, p, \qquad (4),$$

where $CA_{i,j}$ for the cost of storing the component i the day j, $R_{i,j}$ It corresponds to the amount of component i stored during the day j, and CAD_i is the cost of storing one day the component i, those defined in Table 2.

Table 2: costs involved in the daily storage of a component $(CADi)$.

Daily cost of depreciation of buildings and networks for the reception, storage and offices, and handling equipment, air conditioning, weighing, information processing and storage media.
Daily cost of damage, loss, obsolescence and loss suffered by products in the storage period.
Daily cost of packaging, packaging, printing and cleaning materials and office incurred annually warehouse.

Daily cost of energy expended in the warehouse, including the necessary battery charging handling equipment, air conditioning equipment and processing equipment and lighting information.
Daily cost of renting facilities and equipment during storage and communications, taxes and insurance.

Source: Prepared based on Morillo (2009)

The cost of ordering components i required by the type of daily minuta (Mj,p), They were obtained by applying the expression

$CO_{i,j} = (\sum_{h=1}^{3} COD_i) x O_{i,j},\ i = 1, \ldots, p,$ (5)

Where, $CO_{i,j}$ for the cost of ordering the component i the day j, $O_{i,j}$ It corresponds to the amount of orders component i during the day j, and COD_i for the cost of daily order for component i. The sum of COD_i they are listed in Table 3.

Table 3: costs involved in the daily generation of an order for component i(COD_i)

	Daily administrative costs associated with the circuit of an order (input and general service costs for generating order).
	Daily receipt and inspection costs (salary and social laws of the winemaker) circuit linked to an order.
	Means transportation costs related exclusively to generate an order.

Source: Prepared based Hernández-González (2011)

Contribution margins (MCj,p) for the types of daily minuta (Mj,p), They were obtained by applying the expression (6):

$MCj, p = I_{j,p} - (\sum_{i=1}^{p} c_{i,j} + CAD_{i,j} + COD_{i,j}),\ i = 1, \ldots, p \quad j = 1, \ldots, 180,$ (6)

where MCj, p contribution margin corresponds to the minuta type p the day j, $c_{i,j}, CA_{i,j}\ y\ CO_{i,j}$ They are described in (3), (4) and (5) respectively.

In the case of maximizing contribution margins through the inventory policy models that will be displayed in the section 4.4, the equation (6), It will be considered to maximize the objective function such that:

$Max\,[MCj, p] = Max\,\{ I_{j,p} - (\sum_{i=1}^{p} c_{i,j} + CA_{i,j} + CO_{i,j})\},\ i = 1, \ldots, p \quad j = 1, \ldots, 180,$ which considers the characteristics of the types of components contained in each bill to model their demand rate and then assign the management model corresponding inventory.

URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

Modeling the demand for variable rate components in the minutes

For this calculation, it is necessary to program the software free of charge R-project version 2.15.3., occupying the code life_distributions. R, which it contains commands and settings for estimating probability distributions. Second, the computer code called analisis R for each component runs, performing a parametric analysis for the following distributions: Normal, BS, BS-t, Gamma, IG, LN y Weibull. For each of the distributions mentioned, the estimation of the following parameters was obtained: AIC (information criterion Akaike), BIC (information criterion Bayesiano), qq-plot (gráfico cuantil versus cuantil), pp-plot (probability and probability graph), envelopes, test Kolmogorov Smirnonv (ks, para verificar normalidad). Through the envelopes you can see the model that best fits the number of components to sue, according day and type of minuta. Thus, and as expressed in equation. (1), the value of the daily rate of expected demand was obtained ($_i$=E (Q_i),for each component i.

Allocation of inventory management models

According to the characteristics of the component analyzed (fruit, vegetables, meat, cram), an optimization model is assigned:

a) Model for perishable components in a single period: considered the amount needed to optimize the cost of ordering one less (generating a temporary shortage), in contrast to order a unit (generation of a temporary excess), based on the use of a critical reason for component i (RCi) given by the expression (7):

$RCi = \frac{CIi - CN_{i,j}}{CIi + CA_{i,j}}$ (7), donde CIi It is the cost of the lack of a unit of unsatisfied demand for component i (which it includes the cost of lost sales and customer distrust), $CN_{i,j}$ y $CA_{i,j}$ they have been defined in (3) y (4), respectively. In this model, the optimal level of service can be obtained from the expression (8):

$F(y^{\circ}) = RCi$ (8), where $F(.)$ It is the cumulative distribution function y° which represents the optimal number of units to order according to a single period applicable to perishable components, and RCi it has been defined (7). For details on this model please check Hillier & Lieberman (2005, pp. 961-975).

URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

b) Nonperishable model components (multiple periods): It considers that the amount needed to optimize purchasing costs of ordering and storing, based on the existence of an economic order quantity for component i (CEPi) and a point reordering (ri), given by (8) y (9) respectively:

$CEPi = \sqrt{2 \times \lambda i \times CO_{i,j}/CA_{i,j}}$ (8), where $CEPi$ corresponds to the economic amount of order for the component i, λi It corresponds to the rate of daily demand component i, depending on the type of bill p and day j Order assembly (set to 1), $CA_{i,j}$ y and $CO_{i,j}$ and they are defined in (4) y (5) respectively.

Finally, the point of rearrangement (ri) may be expressed as:

$ri = \lambda i \times li + k_q \times \sigma_{D_L}$ (9), where λi It is defined in (1), li corresponds to the latency time (lead time) or elapsed between the generation of a purchase order for the component i and its real readiness to join in the preparation of the minutes time, in our case this value is constant and equal to 3 days, while k_q It corresponds to a factor associated with a given level of service cycle, and σ_{D_L} It is the standard deviation of the amounts claimed during the latency time. As indicated in (9), it is necessary to know the distribution of demand during the latency time to determine the safety factor k_q (Keaton, 1995; Porras & Decker, 2008). This factor can be established by using a percentile associated with demand during the latency period. To be protected against any unexpected situation of logistics, generally considered the 95th percentile (Ballou, 2006). In this paper we use the statistical distribution that adequately meet the demand data to obtain k_q.

a) Model supply just in time (jit): consider ordering the required amount of particular components that have no possibility of storage, and exactly cover current demand.

Supply cost savings, sort and store

The savings in procurement costs, to sort and store, were obtained by contrasting the sum of the costs of individual components over a period of six months, obtained from optimization given by the application to develop, versus those obtained actual costs in the same periods.

Investments and expenses to carry out the supply policy and its assessment of financial

To estimate the required investment, they were taken into account the requirements related to the proposed question for the SAN supply volumes required related to storage, adaptation of facilities and equipment.

Training expenses: costs were considered in training staff in charge of the winery, in order to optimize inventory policies, and that these are carried out fully, in addition to previous requirements calling the technical standards for the staff who will be by cellar.

Projected sales and costs

Based on time-series data 6 months of margins obtained from the empirical study, a projection model quarterly moving average (PMTi) was used:

$$PMT_i = \frac{\sum_{i=1}^{n} Ti}{n}$$

(10), where *Ti* is the value which takes the daily sum for a monthly period variable MCj,p defined in 6), in each period i (months) and n is the number of periods of the moving average of 3 months. On this basis a forecast for the next 5 years was carried out, considering revenue growth and costs of 5% a year, linked to changes in sales prices indexed to the CPI (consumer price index) in the country.

Estimate of the rate of assessment of sustainability of supply policy

To determine this rate method weighted cost of capital and to determine the percentage required by the costs of each of the sources of funding, either equity or third party is used. For costs related to each of the funding sources they were weighted according to the proportion of the costs, according to the expression 11:

$$K'_0 = k_d(1-t)\frac{D}{V} + k_e\frac{P}{V}$$

(11), where D dela is the amount of debt service in question, P the amount of equity, V the value of the assets of the company in the market, K_d is the cost of debt and K_e is the required return on equity. The result we get is a percentage, which sets an acceptance criterion for any return a value of projected future cash flows discounted at this rate, they are a positive net present value (NPV) and percentage are higher than this minimum requirement rate internal return (IRR). (See Sapag, 2003).

Results

"Visión de Futuro" Año 13, Volumen Nº 20, Nº 1, Enero - Junio 2016 – Pág. 141 - 163
URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

In Table 4, a summary of the statistical results and supply model used for the 89 components of the mix of inventories SAN is deployed. This summary indicates, the statistical distribution that best fits the data demand of each component, the optimum amount of replenishment and ROP obtained by applying the inventory model. We have obtained that 46 of the products mix inventory model of perishable products from a single period (perishables), 39 the model EOQ no shortage and 4 to model JIT adjusted, indicating that the total inventory consists mostly type of perishable products (mostly fruits and vegetables).

Table 4. Summary of model parameters supply the 89 components of the mix of inventory service

ID	Component	Inventory model used	Demand rate $\square_i$ (consumed components / day)	Statistical distribution of demand	CEPi no shortage (no shortage optimized amount) (unit or kg)	y° (optimized quantity model for perishable goods) (unit or kg)	ROP (unit o kg)
P1	Oil	CEP no shortage	8,64	BS-t	2127,02		39,77
P2	Chard	perecible	57,86	Lognormal		265,45	173,58
P3	Garlic	perecible	15,81	lognormal		25,22	47,42
P4	Celery	perecible	11,53	BS-t		18,14	34,6
P5	Rice	CEP no shortage	29,22	Lognormal	3910,76		245,24
P6	frozen peas	perecible	8,8	BS-t		15,86	26,39
P7	Oats	CEP no shortage	4	Constante			12
P8	Sugar	CEP no shortage	3	BS-t	1253,03		123,46
P9	bavarois	CEP no shortage	4	Constante			12
P10	beetroot	perecible	22,78	BS-t		34,27	68,34
P11	jerry pulp	CEP no shortage	1	Constante			3
P12	Broccoli	perecible	14,24	Lognormal		20,8	42,73
P13	Ground beef	perecible	21,96	Lognormal		14,79	65,88

P14	American corn	perecible	189,51	Lognormal		378,8	568,53
P15	frozen corn	perecible	11,51	BS-t		17,71	34,53
P16	Sausage	perecible	27,28	Lognormal		19,19	81,83
P17	Plum	perecible	14,87	BS-t		22,3	44,6
P18	Dried plums	perecible	3	Constante		65,58	9
P19	Cauliflower	perecible	18,61	BS-t		26,95	55,83
P20	Concentrate bird	CEP no shortage	1	Constante			3
P21	Tomato concentrate	CEP no shortage	1	Constante			3
P22	Concentrate beef	CEP no shortage	1	Constante			3
P23	Asparagus cream	CEP no shortage	3,87	Lognormal	1423,22		8,48
P24	Creamed vegetables	CEP no shortage	3,6	Lognormal	1372,22		6,63
P25	Unsalted cream	CEP no shortage	0,88	BS-t	679,18		2,51
P26	Cremell	CEP no shortage	4	Constante			12
P27	Peach	Perecible	25,27	BS-t		37,44	75,8
P28	hair pasta	CEP no shortage	2,37	Lognormal	1113,12		11,54
P29	spiral noodles	CEP no shortage	45,91	BS-t	4901,82		687,76
P30	Noodles you mostacholes	CEP no shortage	43,03	Lognormal	4745,61		94,86
P31	Flan with milk	CEP no shortage	3,65	Lognormal	1382,01		7,24
P32	Goose	perecible	84,86	Lognormal		40,61	254,58
P33	Habas	perecible	10	BS-t		10,03	30
P34	Flour	CEP no shortage	7,07	Lognormal	1923,68		27,96
P35	Egg	perecible	92,07	BS-t		159,25	276,2
P36	Jelly	CEP no shortage	1,46	Lognormal	872,95		3,96

P37	window box	perecible	9,81	BS-t		17,6	29,43
P38	Lemon juice	CEP no shortage	11,22	Lognormal	2423,32		28,53
P39	leche asada	CEP no shortage	4	Constante			12
P40	nevada milk	CEP no shortage	4	Constante			12
P41	TKF milk	CEP no shortage	2,12	Lognormal	1054,43		8,13
P42	Lettuce	perecible	47,42	Lognormal		78,43	142,27
P43	lentils	CEP no shortage	32,61	Promedio	4131,08		42,29
P44	Cornstarch	CEP no shortage	2,14	Lognormal	1058,98		4,64
P45	Delicacy	CEP no shortage	4	Constante			12
P46	Apple	perecible	20,38	BS-t	31,68		61,14
P47	Margarine	perecible	2,07	Lognormal	3,75		6,22
P48	Cantaloupe	perecible	10,45	Lognormal	16,99		31,36
P49	Meringue	CEP no shortage	1	Constante			3
P50	Hake	HIT	80,39	BS-t	80,39		241,16
P51	pimento	perecible	10,75	Lognormal	13,6		32,26
P52	lisa mortadella	perecible	5,33	Lognormal	5,3		16
P53	Nickname	CEP no shortage	1,5	Constante			4,5
P54	Mousse	CEP no shortage	4	Promedio			12
P55	Orange	perecible	19,85	BS-t	29,36		59,56
P56	Custard	CEP no shortage	4	Constante			12
P57	Avocado	perecible	13,27	Lognormal	16,31		39,82
P58	Pan beaten	HIT	1	Constante			1
P59	bread bun	HIT	23,21	Lognormal	3485,25		44,56

P60	Pan hallulla	HIT	2	Moda		6
P61	Potatoes	perecible	93,48	Lognormal	198,92	280,43
P62	Chicken breast	perecible	98,06	Lognormal	22,34	294,19
P63	cucumber salad	perecible	45,78	BS-t	68,23	137,34
P64	Pear	perecible	15,05	BS-t	21,23	45,15
P65	Parsley	perecible	11,01	Lognormal	14,05	33,02
P66	Banana	perecible	17,98	Lognormal	28,28	53,93
P67	white beans	CEP no shortage	5,04	BS-t	1624,42	142,86
P68	frozen bean stew	CEP no shortage	1	Constante		3
P69	frozen green beans	perecible	7,67	BS-t	11,91	23
P70	Pork pulp	perecible	68,21	Promedio	34,16	204,62
P71	instant mashed potatoes	CEP no shortage	3,37	Lognormal	1327,98	16,5
P72	quesillo	perecible	10	BS-t	11,34	29,99
P73	Gouda cheese	perecible	4,28	Lognormal	6,93	12,83
P74	Cabbage	perecible	3,67	Promedio	5,69	11,02
P75	salt	CEP no shortage	2,35	Lognormal	1109,04	4,99
P76	Salt in sachet	CEP no shortage	1	Constante		3
P77	dessert sauce	CEP no shortage	1	Constante		3
P78	Watermelon	perecible	4,8	Lognormal	7,52	14,41
P79	Semolina	CEP no shortage	2,93	Lognormal	1238,76	10,34
P80	spaghetti	CEP no shortage	39,19	Lognormal	4529,1	216,61
P81	Assorted seafood	perecible	16,83	Promedio	18,36	50,5
P82	Tapapecho	perecible	39,53	Lognormal	27,33	118,6
P83	Tomato	perecible	35,78	BS-t	56,62	107,35

P84	Grape	perecible	17,7	Lognormal	27,02	53,09
P85	Are you coming to	perecible	27,31	Lognormal	20,18	81,94
P86	Vinegar	CEP no shortage	2,94	Lognormal	1240,52	6,24
P87	Carrot	perecible	18,08	Lognormal	33,08	54,23
P88	zapallo	perecible	26,55	Lognormal	20,97	79,64
P89	Italian zapallo	perecible	135,92	Lognormal	276,62	407,77

Source: Own Elaboration

Table 5 presents the changes in annual costs and unit storage systems providing real and proposed. Storage costs are diminished by 23.7%, resulting in significant savings through improved obtained by the use of inventory models.

Table 6 shows the changes in the costs of ordering annual and weekly in real systems and proposed supply. Costs of ordering a reduction of 40% of the product purchase orders better management of supply and inventory policy occurs.

Table 5. Differences between costs and annual storage unit supply systems indicated

	Real supply			Proposed supply		
Storage costs (CAD_i)	CAD(a) ($)[1]	CAD (s) ($)[2]	CAD(ua) ($)[3] (to 255.480 units/year)	CAD(a) ($)	CAD(s) ($)	CAD(ua) ($) (to 251.668 units/year)
CAD_1	1313772,5	25266,7	5,2	1313772,5	25266,7	5,2
CAD_2	5507733,0	105917,9	21,5	2753868,9	52961,3	11,0
CAD_3	851120,6	16365,9	3,3	851120,6	16365,9	3,3
CAD_4	3638136,2	69966,4	14,3	3638136,2	69966,4	14,3

1 CA(a) ($) It is the annual storage cost $.

2 CA(s) ($) it cost $ weekly storage.

3 CA(ua) (USD$) It is the annual unit cost of $ storage.

"Visión de Futuro" Año 13, Volumen Nº 20, Nº 1, Enero - Junio 2016 – Pág. 141 - 163
URL de la Revista: http://revistacientifica.fce.unam.edu.ar/
URL del Documento: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=409&Itemid=88
ISSN 1668 – 8708 – Versión en Línea
ISSN 1669 – 7634 – Versión Impresa
E-mail: revistacientifica@fce.unam.edu.ar

CAD_5	303176,4	5828,9	1,0	303176,4	5828,9	1,4
Total	11613938	223345,7	45,3	8860074,7	170384,4	35,3

where CAD_i the cost is prorated for total units stored in one year (Morillo, 2009).

Source: Own Elaboration

Table 6. Differences between the costs of ordering annual and weekly supply systems indicated

Ordering costs (COD_i)	Actual supply cost system ($)	Costs supply system proposed ($)
COD_1	242540,2	145523,2
COD_2	2728602,2	1637159,4
CO_{D3}	4850846,7	2910506,1
Total annual cost of ordering	7821993,9	4693193,5
Number of orders / month	20,00	12
Cost of ordering / order	32588,6	32588,6

where COD_i the cost is prorated amount of weekly orders involved in the generation of an order (Hernández-González, 2011).

Source: Own Elaboration

The investments to be made to assess the sustainability of supply policy proposal depended on the calculation of the dimensions and requirements of storage areas, which were made for the maximum amounts of supply of each component in relation to optimization stock raised, see Table 7.

Table 7. Dimensions for each storage area in Kg.

Zone	Kg Food
Bodega	58675
Vitrinas refrigeradas	96
Congeladores	505
Cámara de drío	1842
Total	61118
Toneladas	61
Toneladas/M³	61

Source: Own Elaboration

Below in Table 8, the remodeling budget (in Chilean pesos), necessary for the implementation of system optimization and inventory policies shown.

Table 8. Budget remodeling necessary for system optimization and inventory policy

DETAIL	QUANTITY (units)	PRICE (units)	TOTAL
metalcom upright wall 38 x 38 x 6 x250 cm	58	$ 1.000,00	$ 58.000,00
metalcom channel wall 29x20x5x300 cm	85	$ 798,00	$ 67.830,00
volcanita 15 mm 129 x 240 rh plasterboard walls (plate)	50	$ 16.090,00	$ 804.500,00
volcanita 15 mm 120x240 rh plasterboard ceiling (plate)	22	$ 16.090,00	$ 353.980,00
Lentil head screws 1/2 "drill bit tip 100 8x1 inch box	10	$ 664,00	$ 6.640,00
roof pillar wall 38 x38 x6 x5x 250 cm	30	$ 788,00	$ 23.940,00
channel wall 39x20x5x300 cm	41	$ 1.000,00	$ 41.000,00
astatic flat roll	48	$ 7.990,00	$ 383.520,00
Trancura's pine wood door oregon 4.5 mmx80cm x 2 cm	2	$ 42.990,00	$ 85.980,00
mortise lock d1113 chrome office	1	$ 17.190,00	$ 17.190,00
tubular lock y815 stainless steel bedroom	1	$ 16.390,00	$ 16.390,00
steelock hinge l84 2 1/2"x2.1/2" loose pin 2 units	2	$ 1.790,00	$ 3.580,00
enamel white water 40 mt2	6	$ 6.086,00	$ 36.516,00
glass fiber self-adhesive tape jubtas 5cm x 45 mm	20	$ 1.120,00	$ 22.400,00
smooth inner wall paste (gallon)	10	$ 2.950,00	$ 29.500,00
		TOTAL	$ 1.950.966,00
		%E.M 0.03	$ 294.375,00
		TOTAL FINAL	$ 2.245.341,00

Source: Own Elaboration

Below in Table 9 shows investment in necessary equipment and its application in the Chilean peso.

Table 9. Investment in equipment

Equipment	Required quantity	Unit cost	Cost	TOTAL + VAT
cooling chamber	1	$ 4.825.260,00	$ 4.825.260,00	$ 5.742.059,40

zinc plated shelf 120 x 60 model EZ-120	13	$ 119.000,00	$ 1.547.000,00	$ 1.840.930,00
zinc plated shelf 90x60 model EZ-90	5	$ 101.150,00	$ 505.750,00	$ 601.842,50
1 door refrigerated cooler	2	$ 261.800,00	$ 523.600,00	$ 623.084,00
chest freezer 120 ltrs	2	$ 190.400,00	$ 380.800,00	$ 453.152,00
TOTAL				$ 9.261.067,90

Source: Own Elaboration

Below in Table 10 an annual schedule of training is presented by value, according to the topics. The value of each time is calculated according to time NTC (National Training Company), at $ 5000 maximum per participant, classroom training courses.

Table 10. Training Scheme valorized

Month 1	4 Hours	$20.000
Month 2	2 Hours	$10.000
Months nexts	1 Hour/Month	$5.000
Annual	16 Hours	$80.000

Source: Own Elaboration

Finally, the projected savings (income) in Chilean pesos ($), according to current exchange rate was made with time series of empirical data obtained by comparing the situations with and without policy implemented supply, which provided actual data six months, based on this model quarterly moving average (QMA) was used. The result for the first 12 months was expressed below in Table 11:

Table 11. Projected savings the first year with inventory policy proposal

MONTH	INCOME
1	-$ 5.755.810,00
2	$ 2.373.215,00
3	$ 1.443.261,00
4	$ 1.639.712,00
5	$ 2.783.878,00

6	$ 1.642.819,00
7	-$ 192.116,00
8	-$ 1.676.997,00
9	$ 1.890.923,00
10	$ 1.523.960,00
11	$ 2.201.614,00
12	$ 2.208.988,00
TOTAL	$ 10.083.447,00

Source: Own Elaboration

The result of savings (income) projected for the 5-year evaluation was expressed below in Table 12:

Table 12. Projected in 5 years with the savings proposed inventory policy

Year	Income
1	$ 10.083.451,00
2	$ 11.348.422,00
3	$ 11.583.755,00
4	$ 12.135.558,00
5	$ 12.890.666,00
TOTAL	$ 58.041.852,00

Source: Own Elaboration

The rate of assessment of the sustainability of supply policy to implement stood at 12.16%, given the following records found:

Financing rate	***kd***	**8%**
Tax Rate	(1-t)	81%
Debt / total assets	D/V	0,33333333

Race owner	ke	15%
Relationship equity / total assets	P/V	0,66666667

The result of NPV for this project estimated flows for a period of 5 years is $ 147,895.50. Therefore the investment will produce profits above the required return. While the result of IRR for this project is 13%, being greater than the required fee, so the project should be accepted. Below in Table 13 cash flows calculated for the evaluation of the investment project for the first year and a projected 5-year period (Table 14) are shown, considering the differential values of the situation with and without the project.

Table 13. Cash flow for the first 12 months with the inventory policy proposal

	Month 0	1	2	3	4	5	6	7	8	9	10	11	12
Income		-$ 5.755.810,00	$ 2.373.215,00	$ 1.443.261,00	$ 1.639.712,00	$ 2.783.878,00	$ 1.642.819,00	-$ 192.116,00	-$ 1.676.997,00	$ 1.890.923,00	$ 1.523.960,00	$ 2.201.614,00	$ 2.208.988,00
Initial investment	$12.656.408,90												
Salary Bodeguero		$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00	$ 360.000,00
Training		$ 20.000,00	$ 10.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00	$ 5.000,00
Secure		$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00	$ 125.000,00
Depreciation		$ 114.597,92	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00	$ 123.567,00
Interest		$ 27.333,00	$ 26.961,00	$ 26.587,00	$ 26.210,00	$ 25.830,00	$ 25.448,00	$ 25.064,00	$ 24.677,00	$ 24.287,00	$ 23.895,00	$ 23.500,00	$ 23.120,00
Profit before tax		-$ 6.402.740,92	$ 1.727.687,00	$ 803.107,00	$ 999.935,00	$ 2.144.481,00	$ 1.003.804,00	-$ 830.747,00	-$ 2.315.241,00	$ 1.253.069,00	$ 886.498,00	$ 1.564.547,00	$ 1.572.301,00
Tax			$ 328.260,53	$ 152.590,33	$ 189.987,65	$ 407.451,39	$ 190.722,76			$ 238.083,11	$ 168.434,62	$ 297.263,93	$ 298.737,19
Profit after tax		-$ 6.414.709,54	$ 1.399.426,47	$ 650.516,67	$ 809.947,35	$ 1.737.029,61	$ 813.081,24	-$ 830.747,00	-$ 2.315.241,00	$ 1.014.985,89	$ 718.063,38	$ 1.267.283,07	$ 1.273.563,81
Depreciation		$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54	$ 123.566,54
Amortization		$ 55.800,00	$ 56.172,00	$ 56.546,00	$ 56.923,00	$ 57.303,00	$ 67.685,00	$ 58.069,00	$ 58.457,00	$ 58.846,00	$ 59.239,00	$ 59.633,00	$ 60.031,00
Net Cash Flow	-$ 12.656.408,90	-$ 6.346.943,00	$ 1.466.821,01	$ 717.537,21	$ 876.590,89	$ 1.803.293,15	$ 868.962,78	-$ 765.249,46	-$ 2.250.131,46	$ 1.079.706,43	$ 782.390,92	$ 1.331.216,61	$ 1.337.099,35
Net Value Present	-$ 14.528.686,00												

Source: Own Elaboration

Table 14. Cash flows projected to 5 years with the inventory policy proposal

Year	0	1	2	3	4	5
Income		$10.083.451,00	$11.348.422,00	$11.583.755,00	$12.135.558,00	$12.890.666,00
Initial investment	$ 12.656.408,90					
Salary Bodeguero		$4.320.000,00	$4.341.600,00	$ 4.363.308,00	$ 4.385.124,54	$ 4.407.050,16
Training		$ 315.000,00	$ 315.000,00	$ 315.000,00	$ 315.000,00	$ 315.000,00
Secure		$ 1.500.000,00	$ 1.500.000,00	$ 1.500.000,00	$ 1.500.000,00	$ 1.500.000,00
Depreciation		$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00
Capital payment		$ 694.704,00	$ 752.364,00	$ 814.811,00	$ 882.440,00	$ 955.683,00
Profit before tax		$ 1.770.958,00	$ 2.956.669,00	$ 3.107.847,00	$ 3.570.204,46	$ 4.230.143,84
Tax		$ 336.482,02	$ 561.767,11	$ 590.490,93	$ 678.338,85	$ 803.727,33
Profit after tax		$.434.475,98	$ 2.394.901,89	$ 2.517.356,07	$ 2.891.865,61	$ 3.426.416,51
Depreciation		$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00	$ 1.482.789,00
Amortization		$ 302.920,00	$ 245.235,00	$ 182.788,00	$ 115.161,00	$ 41.917,00
Net cash flow	-$12.656.408,90	$ 2.614.344,98	$ 3.632.455,89	$ 3.817.357,07	$ 4.259.493,61	$ 4.867.288,51
Net Present Value	$ 701.280,15					
Internal rate of return	14%					

Source: Own Elaboration

Discussion

Our results are in agreement WITH some authors SUCH as Ramanathan (2006), who, occupying linear programming models, related minimizing inventory costs to maximize the contribution margins in products called critical or classification A inventory, which corresponds to approximately 20% of the total product references that make up the mix, and are responsible in a proportion of about 80% of the total contribution margin observed. In the case of SAN, the models used mostly adjusted to fruits and vegetables, which are perishable products unit contribution margins higher level, and that can be considered critical in this mix of products. With respect to the quantities of products that optimize margins total contribution by absorption, it is important to note that, for setting a model EOQ no shortage, they are considerably higher than the rate of demand, because the products can be stored for indefinitely, without losses caused by maturity, a condition that is used to decrease the cost that is incurred when an order is generated. The products that fit the model of perishable goods from one period present an optimized amount similar to the rate of demand. This is explained because these are products that have a shelf life (fruits, vegetables and meats), which allows them to be stored for an extended period of time, so the adjustment model is quite successful for this type of products, since their replacement is limited and considered minimum levels of stock in storage. Only a small (about five percent of the total) of the products conform to JIT replenishment type, where the quantity to order is equal to the amount to occupy. Therefore, replacement of products occurs at the time to be using this product, ie, as the demand does not change, the quantities to order are the same, why can not optimize the utility in these products (Hillier & Lieberman, 2005).

In the first week of the study, we identified that there is a considerable difference between the two margins weekly total contribution, which is explained by the amount of products to be supply, given mainly by products that EOQ model fit no shortage as it occurs an initial order that is even able to solve the entire period of study in some products, minimizing the direct and indirect costs associated in subsequent weeks. Importantly, the inventory models used in this study are based on minimizing costs to purchase, store and sort, which generate a valid efficiency for products that eventually make profits or margins variables contribution are positive (Hillier & Lieberman, 200). For this reason, products that have margins of variable contribution with negative values should be treated through models that consider this condition, because in this category must meet certain basic requirements that are stipulated in the bidding concessions, forcing the company to use any of these products.

It is worth mentioning that, although we have achieved a significant improvement in contribution margins of Chilean food service (7.7% increase in contribution margins and a reduction of 27% and 40% in the costs of storing and order, respectively), using a system of supply and inventory policy based on inventory models with random demand, there are still some statistical and modeling aspects that can be improved. For example, it is possible to explore the use of models that consider statistical dependence in time and between products.

CONCLUSION

The results of this study indicates the importance of including models of supply and inventory policy aspects to consider statistical adjustment for the area of logistics companies. These models should be adjusted according to the probabilistic demand for products in food services, with the ability to automate the management of supply, improving decision-making. The decrease of the indirect costs of storage and order are valid to say that, taking the inventory models described in this paper, it is possible to form supply systems and inventory policy commensurate with the type handled in food services products argument, with an improvement in systematizing the needs of the production unit and making profitable management. This result was achieved through an intervention that resulted in the improvement of supply and inventory policy Foodservice. The decrease in direct and indirect variable costs are absorbed in contribution margins, it was achieved by the use of these models in minimizing the total inventory costs, generating a greater margin attributable to good modeling demand products. It is possible to validate improvements in logistics management through the application of a suitable projection of the implementation of this policy supply, obtaining a greater margin of total contribution by absorption of costs in a sustainable manner over time, even absorbing investments and expenses that the implementation of this may require.

BIBLIOGRAPHY

Please refer to articles in Spanish Bibliography.

BIOGRAPHICAL ABSTRACT

Please refer to articles Spanish Biographical abstract.