

TECHNICAL UNIVERSITY OF NORTH



**FACULTY OF ENGINEERING IN APPLIED SCIENCES
INDUSTRIAL ENGINEERING DEGREE
DEGREE PROJECT**

SCIENTIFIC ARTICLE

SUBJECT: Feasibility study for the expansion of production of the DP Global Service company capacity

AUTHOR: Pablo Chiriboga

DIRECTOR: MSc. Eng. Carlos Machado

IBARRA - ECUADOR

2017

FEASIBILITY STUDY FOR THE EXPANSION OF THE PRODUCTIVE CAPACITY OF THE DP GLOBAL SERVICE COMPANY

Pablo Emilio Chiriboga Guanoluisa

University North technique, Av. 17 de July 5-21 and Gral. José María Córdova, (593-6) 2997800 ext. 7070 Ibarra, Imbabura

Faculty of engineering in applied science - mechanical engineering

pechiriboga@utn.edu.ec

Abstract. *The following degree work show the results obtained about a study carried out in the production area of separadores of the company DP Global Service, located in Tabacundo, with the purpose of determining the feasibility of the expansion of productive capacity. This productive plant had several problems associated mainly with its limited size as: disorder, hindered corridors and increased production times, complicating her ability to meet customer needs and expanded in the market. By means of the project evaluation were studied different topic of market, technical and financial, with the purpose of find an economically viable solution.*

The proposed methodology has the particularity of being applied for the evaluation of the increase of the installed capacity of companies of manufacture. This began with the bibliographic compilation about project evaluation, next was made a situational diagnostic of the plant. Finally, a feasibility study was developed, which consists of four stages: In the first stages (the market study) was made an analysis of supply and demand based on the behavior of the company's historical sales. In the second part was made a technical study for determine topic as machinery, distribution of plant and the resources necessary to carry out the capacity increase. Later, in the financial study was evaluated the feasibility of the project through three evaluation indicators: VAN, TIR and C/B, after that was calculated the total investment required for the implementation this project. Finally, in the study of impacts was evaluated the possible impact economic, social and environmental implications of the project.

The project proved viable in view of its compliance with the three evaluation criteria used,

The results obtained were: a positive VAN of USD 18.912,19, a TIR of 18,13% and a cost benefit relation of 1,41.

KEY WORDS:

Pads, capacity, increase, flower market, feasibility.

1. Introduction

DP Global Service is one of the pioneers in the production of separators for bunch of roses in Tabacundo. During its short life has experienced high growth in sales this, however, has meant him a progressive reduction of spaces in the production plant, as well as several difficulties to meet the growing demand.

The initial capacity of the plant of separators was designed without any kind of planning in the future, so as time passed and the production levels grew was increasingly more complicated to meet the demand. The main problem was in the warehouses of raw material and finished product, since these areas require a lot of space both to store material and for its transport and handling. Without enough space to store the products properly, operators saw the need to invade other areas and jobs, in order to meet your production goals.

The application of evaluation of projects in this area of study is justified since to find solution to the problems of space and increase plant capacity, required inevitably a large injection of resources, so it is convenient to evaluate whether the alternatives selected to solve these problems are profitable or not.

Four complementary studies were carried out to complete the evaluation of the project: market, technical, financial and impact. These studies provided sufficient information to determine the feasibility of the expansion of the productive capacity in the area of production of separators.

2. Materials and methods

For the evaluation of increase in installed capacity in the area of separators used the methodology proposed by Baca Urbina (2010). Like the method normally used to evaluate the project of a new production company, the methodology used for this project consisted of the same aspects, this were: a market analysis, a technical study, an aspect of economic analysis and finally a financial assessment. The main difference was only the source of the data to analyze, whose sources were mostly of the Organization itself, since these reflect better the performance of the company in the market..

3. Results

3.1 Situational analysis

Distribution of plant

The situational analysis of the plant's production of separators began with an analysis of the distribution of plant. The main problems encountered on the ground were: reduced spaces in storage areas, narrow roads, poor organization of the jobs and disorder.

A study of sizing determined the real space of the plant requirements, concluding that there is a deficit of spaces of 40%, as shown below:

Description	Current area (m ²)	Area required (m ²)
Raw material storage area	10.5	25
Storage product in process area	3.3	3.3
Strip storage area	2.64	3
Finished product area	13.4	18.5
Since RIP	9	10
Since cutting of sheets	9.5	13
Halls	14.3	20
Work tables	3.4	3.4
Bathroom	2.4	2.4
Total	68.4	98.6

Table 1 areas recommended for the jobs of the plant's production of separators

Description of the process of production of separators

The operations that are performed within this area are described below:

- **Raw:** The raw material (sheets of cardboard) arrives in trucks or container, which is transferred to the area of storage of raw where are stacked in columns of up to 4 meters high.
- **Cutting:** process in which workers cut the sheets of cardboard through the refiladora, in order to obtain strips and finally transfer to the Strip storage area.
- **RIP:** Making use of the circular saw operator cut strips obtained in the previous process, obtaining in this way separators.
- **Packing:** At this late stage separators are wrapped in stretch film for finally be stored and marketed.

Time study

A series of steps, which are described below is carried out to determine the standard times in the area of production of separators:

- **Preparation**

The process began with the selection of the operation to be considered and the selection of operators. In this case when there is only two workers in the area became decision time in both.

- **Execution**

The operations described above it decomposed them is on "elements" in order to make reliable measurements. In total there were 19 operations.

Once defined the elements was to calculate the number of observations by Abacus of Lifson, for which an initial sample of 10 observations is taken. The number of measurements to be made according to this method was 25 observations per element.

Once defined the elements and the number of observations to be held, was the measurement of time. The technique used during this stage was back to zero. The measurements were collected at registration of time, which were also recorded various data including: machinery and tools used, date and time of the recording time and some remarks about processes in study.

- **Supplements**

The calculation of the supplements did is based on the table of play recommended by the international organization of labour (ILO).

Supplements selected for this study are shown below:

SUPPLEMENTS	Raw	Cutting	RIP	Packing
Constant supplements	%			
Personal needs	5	5	5	5
Basic fatigue	4	4	4	4
Variable supplements	%			
Foot work	0	2	2	2
Use of force, or muscle power (lifting, pulling or pushing): 10 kg	3	3	1	1
Noise: Intermittent and strong	0	0	5	0
Algebraic sum	12	15	17	12
Supplement total (%)	0,12	0,14	0,17	0,12

Table 2 supplements of the area of production of separators

- **Standard time**

Standard time was defined by determining the frequency with which each element is repeated in the first place. Subsequent to this, and once assigned supplements proceeded to the calculation

of standard time by means of the following equation:

$$Ts = TN \times (1 + \% \text{ supplements})$$

The determination of the standard time of each element is shown below::

Operation	Element	Standard time
Raw	Load of sheets packages	11.94
	Stacking foils Pack	26.93
	Align piles	17.14
Cutting	Lower blade bulk	18.70
	Transfer sheet to refiladora	36,02
	Loose sheets	14.55
	Cutting	76,29
	Collection of strips	38.81
	Transfer strips to storage	33,29
	Transport of strips to the sierra	78,01
RIP	Grouping strips	45,89
	RIP	334,98
	Stack separators	315,99
	Transportation of piles to table	86,30
	Laying of stretch film	18.89
Packaged	Load separator to area of packed	13.22
	Line upper and lower parts of the package	52,89
	Line sides of the package	64,22
	Packet transfer to storage	39,67

Table 3 Standard time

The cycle time for the production of thousand separators is 15.36 minutes.

Production capacity

Once obtained the cycle time were four indices, with which determined the performance of the system.

Installed capacity	10.5 million units/year.
Effective capacity	7.8 million units/year
Efficiency	54,81%
Use	76.7%

The indicators show a low rate of utilization of facilities, these in turn reflect low efficiency in the production process which may corroborate to observe the performance of the plant during times of high demand in which the company has had to work overtime and outsource additional staff, this despite the fact that the plant has sufficient capacity to meet the orders. Another factor influencing the low rate of use are excessive transport of material that must be operators and little technification process.

2.2 Feasibility study

Market study

Separators are pieces of corrugated cardboard designed to provide better strength and rigidity to the bunch of roses and thus protect the buttons during transport. They are manufactured in a myriad of measures, according to the customer's need. For sale and distribution packaged them is at thousand units with plastic packages for palletizing or stretch film, a transparent and stretchable plastic which surrounds and protects against damage to the product.

Feature	Description	
Appearance	Color	Crude oil White
	Cutting finish	Smooth
Size	According to the customer's needs	cm
Weight	Kraft	125 GSM ²
	White	150 GSM ²
Wavy	C flute	3.5 mm minimum
	B-flute	2.3 mm minimum

Table 4 physical characteristics of separator

The demand analysis carried out on the basis of the historical data of the company since they reflect better the performance of the Organization in the market. To historical sales data analysis, it was determined that these show clearly seasonal behavior of growing trend, reason why the Holt-Winters additive method was used for the projection of demand. The software used was the CRISTALL BALL.

According to the forecasts made, it was determined that for the next three years the trend in the demand for separators has a rate of 42% annual increase.

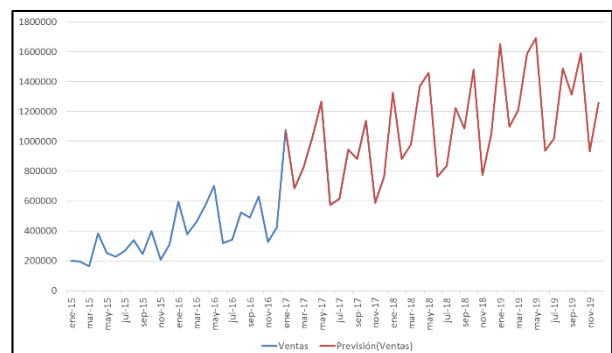


Figure 1 Historical behavior of sales and demand projection

Considering that it is a project of capacity increase, the potential demand unsatisfied in this is the difference between the projected demand and installed capacity (offer). As mentioned above the installed capacity in the

area of production of separators is 10.5 million units/year.

The following graph shows the behavior of the demand against the production capacity of the plant. It can be noted as given the growing expectations that the company, in the near future not is can adequately the demand, which will force it to take the decision to increase the installed capacity.

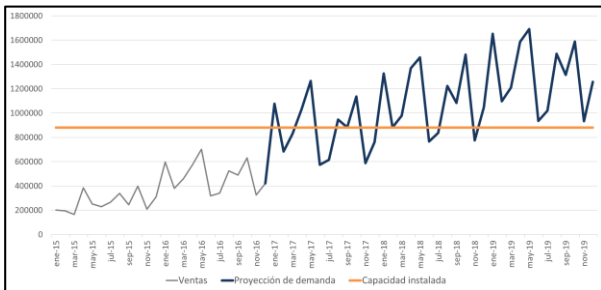


Figure 2 Maximum production capacity versus projected demand

To achieve a good position in the market and meet sales goals, some market strategies, to be taken such as improving the service customer, increased investment in advertising and the contraction of a vendor who will be responsible for increasing sales and find new customers. A factor of differentiation in the markets of separators, is price, which is recommended, as well as marketing strategies mentioned above, adopt measures allowing to maintain highly competitive prices.

Technical study

The company owns with existing facilities an area of land of 1100 m², place where will be built a shed, for the transfer of the entire production of separators.

Taking as a point of reference the size of plant and the surface of the existing facilities, was determined that the barn will possess a rectangular section of 12 × 16 m. The dimensions of workplaces and storage areas for the new plant were also calculated.

N O.	Area or job	Surface (m ²)
1	Raw material storage area	54
2	Strip storage area	11
3	Finished product storage area	38
4	Set of packaged	9
5	Cutting of plates	20
6	RIP	12
7	Halls	48
Total		192

Table 5 Dimensions of the areas of production of separators

Chord data analyzed in the study of market and considering that there is no limiting from the technological point of view it was determined that the installed capacity of the new project would be 15.8 million units/year. During the first year is planned to reach 70% of the installed capacity, while the company is positioned and trade relations are strengthening is expected to increase the capacity at a rate of 10% a year, reaching occupy 90% of capacity in the third year.

Year	Production volume (Units/year)	% use
1	11088000	70%
2	12672000	80%
3	14256000	90%
Installed capacity	15840000	100%

Table 6 production capacity projected of the area of production of separators

Two main problems in the production process were detected during the diagnosis: a method of packaging inefficient and obsolete cutting machinery. In the engineering of the project alternatives, allowing to solve those problems were sought. To increase productivity in the process of cutting of strips, as well as improve the quality of the cut, it was decided to saw replacement by a semi-automatic cutting machine. While an orbital machine was designed to improve the packaging and the number of units was reduced by package to 500. Such improvements seeks to decrease the cycle time to 9.28 min/unit (a 39,58% reduction). This would imply that the new plant will reach a production volume of 14,44 million u/year, which is equivalent to 91,16% of installed capacity proposed for this project.

He designed the layout of plant, made by making use of the SLP tool methodology widely used to solve problems of distribution of plant..

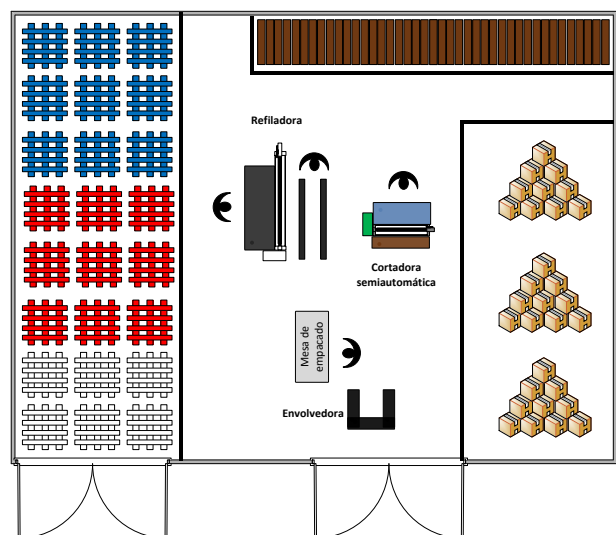


Figura 1 Designed the layout of plant

Economic and financial analysis

In set of investments to be made to implement the project was divided in three areas: fixed investments, deferred investments and working capital. The total amount of investment amounted to USD 46.208,72.

Detail	Total value (USD)
Fixed investments	
Infrastructure (industrial shed)	13.357,21
Machinery and equipment	7.380,00
Tools	23,70
Muebles y enseres	220,00
Deferred investments	
Feasibility study	140
Patent	250
Working capital	
Direct raw	21.567,65
Matter Prima hint	241,36
Direct labor	1.979,75
Unforeseen	1.049,05
Total	46.208,72

Table 7 total investment of the project

It was obtained project incremental revenue by multiplying the average unit price by the quantity of additional demand that would be reached if you deploy the project. The calculation of the price of the product for the following years did is considering a rate of 3.42% inflation.

Detail	2017	2018	2019
Demand (units)	5.332.038	6.916.038	8.500.038
Average unit price (USD)	0,0335	0,0339	0,0346
Incremental revenue	178.755	234.723	294.319

Table 8 income projection

For incremental expenditures budget took into account production, as well as those financial expenses and sales costs determined during the technical study.

Detail	Amount (USD)		
	2017	2018	2019
Production costs	143.583,11	227.965,46	277.512,25
Selling expenses	2708,74	2830,24	2957,29
Financial expenses	1101,31	2281,36	3545,78
Total of expenses	147393,16	233077,06	284015,32

Table 10 Projection of expenditures

With the information gathered previously built in cash flow which is a statement that sums up the inputs and outputs of cash throughout the life of the project, so you can determine the profitability of the investment. The method used to create the cash flow was the direct method, which is determined by the difference of

revenues and projected expenditures of cash that will shed the company for its operations..

RUBRO	Monto (USD)			
	0	1	2	3
(+) Ventas	176.871,79	279.692,47	340.818,39	
Total de ingresos	176.871,79	279.692,47	340.818,39	
(-) Costos de producción	143.583,11	227.965,46	277.512,25	
Materia Prima directa	129.405,92	212.693,54	261.085,01	
Mano de obra directa	11.878,50	12.449,69	13.048,34	
Costo indirecto de fabricación	2.298,69	2.822,24	3.378,90	
(-) Gastos de operación	2.708,74	2.830,24	2.957,29	
Gastos de ventas	2.708,74	2.830,24	2.957,29	
(-) Gastos financieros	1.101,31	2.281,36	3.545,78	
Intereses	1.101,31	2.281,36	3.545,78	
(-) 15% Participación a trabajadores	4.228,39	6.798,91	8.327,06	
(-) 22% Impuesto a la renta	5.271,40	8.475,98	10.381,07	
(-) Inversiones fijas	20.980,91			
(-) Inversiones diferida	390,00			
(-) Capital de trabajo	24.837,81			
Total de egresos	46.208,72	156.892,95	248.351,95	302.723,45
(-) Flujo Neto	-46.208,72	19.978,84	31.340,53	38.094,94
(-) Flujo Neto actualizado	-46.208,72	17.248,36	23.359,37	24.513,18

Table 9 Cashflow

Evaluation of the project

The following table shows the net present value, the internal rate of return (IRR) and the benefit-cost reason (b/c), which are the criteria used to assess this project:

Criterion	Value
TMAR	15,83 %
V.A.N	USD 18.912,19
T.I.R	18,13%
Reason B/C	1,41

From the financial point of view the project is feasible, due to:

- The net present value is positive.
- The internal rate of return is greater than the minimum acceptable rate of return
- Why benefit - cost is greater than 1

4. CONCLUSIONS

- ✓ (Baca Urbina, 2010) methodology to evaluate the increase of the installed capacity of the project consisted of three phases: analysis of the market, technical and financial evaluation study. The data used for this study came from sources most of the Organization itself, since these reflect better the performance of the company in the market.
- ✓ Using the situational analysis determined the existence of a deficit of spaces of 40% in the area of production of separators, as well as several problems in the distribution of plant.

Were also different flaws in the process such as: low level of use of facilities (54,81%), inefficient working methods and obsolete machinery

- ✓ Threw the feasibility study resulted in the implementation of the project is viable in view that meets all the criteria of evaluation applied: A net present value (VAN) positive and whose value amounts to USD 18.912,19, an internal rate of return (IRR) of 18.13% exceeding the take whose value was 15.83% and finally a benefit whose income was \$1.41

[13] Paillacho , D. (2012). Estudio de factibilidad para la creación de una empresa importadora y distribuidora de cajas de cartón corrugado para el sector florícola en la zona de tabacundo. *Pontificia Univeridad Católica del Ecuador sede Ibarra*. Ibarra, Ecuador.

[14] Romero, B. (2016). Adiós a la época dorada del sector florícola. *Revista Gestión*, 50-53.

[15] Sapag Chain, N. (2008). *Preparación y evaluación de proyectos* (Quinta ed.). Bogotá D.C.: McGraw-Hill Interamericana S.A.

[16] Vargas, R. (2007). Estado de flujo de efectivo. *InterSedes: Revista de las Sedes Regionales*, 111-136.

BIBLIOGRAPHIC REFERENCES

- [1] Arcila, W., & Et al. (2016). Metodología de la planeación sistemática de la distribución en planta (Systematic Layout Planning) de Muther. Obtenido de http://www.academia.edu/download/46317235/METODOLOGIA_SLP_1_1.pdf
- [2] Canales, R. (2015). Criterios para la toma de decisiones de inversiones. *Revista Electrónica de Investigación en Ciencias Económicas*, III. Obtenido de <https://dialnet.unirioja.es/descarga/articulo/5140002.pdf>
- [3] Díaz, C. (2014). *Manual autoformativo: Ingeniería en métodos*. Lima: Rebelars S.A.C.
- [4] Espinoza, S. (2007). *Los proyectos de inversión: evaluación financiera*. Cartago: Editorial tecnológica de Costa Rica.
- [5] García Criollo, R. (2005). *Estudio del trabajo Ingeniería de métodos y medición del trabajo* (Segunda ed.). Mexico: McGraw Hill.
- [6] Guzman Castro, F. (2002). El estudio financiero y la evaluación de proyectos de ingeniería. *Ingeniería e Investigación*, 19-19.
- [7] Heizer, J., & Render, B. (2009). *Principios de administración de operaciones* (Septima ed.). México: PEARSON EDUCACIÓN.
- [8] Jaramillo , R., Jaramillo, J., Chávez, L., & Moya, J. (2016). Análisis del valor del dinero en el tiempo para el desarrollo sostenible de las empresas. 3579-3594.
- [9] Malhotra, N. (2008). *Investigación de mercados* (Quinta ed.). México: PEARSON EDUCACIÓN.
- [10] Mete, R. (2014). Valor actual neto y tasa de retorno: su utilidad como herramienta para el análisis y evaluación de proyectos de inversión. *Fides et Ratio-Revista de Difusión cultural y científica de la Universidad La Salle en Bolivia*, 67-85.
- [11] Morales, A., & Morales, J. (2009). *Proyectos de inversión Evaluación y Fomulación*. México: McGraw Hill.
- [12] Niebel, B., & Freivalds, A. (2009). *Ingeniería industrial: Métodos, estándares y diseño del trabajo* (Duodécima ed.). Mexico: INTERAMERICANA EDITORES, S.A. DE C.V.

About the authors...

Author Sr Paul Chiriboga : Student engineering industry of University technique of the North, participant of the Congress of Industrial Engineering and racing, carried out in the cities of Ibarra and blanket.

Co-author MSc. Eng. Carlos Machado: Industrial Engineer, currently Professor of Industrial Engineering.