ECONOMIC VIABILITY ANALYSIS AS A TOOL TO SUPPORT VOIP IMPLEMENTATION PROJECTS AIMING SUPPLY CHAIN INTEGRATION: A CASE STUDY IN A COMPANY FROM THE FOOD INDUSTRY

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In the twenty-first century, all the organizations are affected directly or indirectly by the use of Information and Communication Technologies (ICT's). The development of good ICT implantation projects is extremely important for a company to remain competitive in the market. In this context, the objective of this article is to analyze the importance of an economic viability analysis as a support tool for decision making in ICT implantation projects for micro and small enterprises of the food industry, and also to show how important the supply chain integration is in this section, and how the ICT's can help this integration. To achieve this objective, a case study was conducted in order to support the comprehension about the importance of the economic viability analysis as a tool to evaluate ICT implantation projects, so that investments will not only be guided by the intuition of decision makers.

Palavras-chaves: Project viability, supply chain integration, information and communication technology, food industry

1 Introduction

The great transformations introduced by Information and Communication Technologies (ICT's) changed radically the way organizations do business. The innovations introduced by these technologies led to a great performance improvement, and are considered basic requirements for the company's survival.

According to Laudon (2004), organizations operating in the same business sector can use Information and Communication Technologies to develop information exchange standards, which forces the market participants to adhere to similar standards to remain competitive.

In the food industry, strong links in the supply chain play important roles in the success of a company, due to seasonality and perishability of its inputs. To achieve this important goal, modern information systems are used to enable the efficient information exchange throughout the entire chain, resulting in cost savings and agile business transactions.

According to the Brazilian Association of Food Industries (2006), the food industry has significant participation in the Brazilian economy, contributing about 9 % of the Gross Domestic Product (GDP) and accounting for approximately 17,3 % of the processing industry in the country. According to the same association, the sector is composed by a large number of micro and small firms (which account for 95.9% of total) that usually operate in regional markets, which is locally important to create jobs and generate wealth. The micro and small firms from the food sector have a **s**mall-scale production**,** generally products of low technology sophistication (often craft). This is a productive sector with an extensive supply chain that includes links from agriculture and cattle raising to the final consumer.

Although the information systems literature presents many studies concerned about ICT implementation projects, just a few mention supply chain integration in the food industry, and researches in this area are very sparse or even nonexistent, especially when it comes to micro and small enterprises (MSEs). The objective of this study is to analyze how important the economic viability analysis of projects is for ICT implementations in MSEs, and at the same time it shows how ICT's can provide competitive advantage to a company in the sector to improve the supply chain integration and reduce communication costs. To achieve this goal, was conducted a case study to help understanding the most relevant factors in the economic viability analysis of a project, discussing how this analysis can contribute to a successful ICT implementation in this firms and contribute to understanding how such companies have done the evaluation of their investments in this area.

This article will be divided into six sections: section 1, section 2, section 3, section 4, section 5 and section 6. The section 1 will present the work, as well as its context and relevance; The section 2 will present the theoretical basis, the importance of the ICT projects, the viability analysis of these projects and how the ICT's can influence the supply chain integration in the food industry, section 3 will present the methodology used in the study, and section 4 will present the unit studied, followed by the description of the business problem presented in the study and the proposed ICT project to resolve it, The section 5 will present the viability analysis of the project, describing the project and the use of quantitative methods to support the analysis; to conclude, section 6 will present the final considerations of this work .

2 Theoretical basis

2.1 ICT implementation projects

The ICT implementation can involve the use of a large number of resources, requiring deep changes in an organization. The economic viability analysis is extremely important for the commitment between the leader of a company and the leader of the project.

In 1994, Strassmann (1997) analyzed 539 companies in the United States, Canada and Europe and found out that there is no correlation between the intensity of investment in ICT and the profit obtained by the company. With this result, the author proved that companies that invest more in ICT's not necessarily get the best results.

This fact emphasizes the need for appropriate ways to evaluate investments in ICT, in order to support the decision-making process, usually based on the decision maker's intuition.

According to Colangelo Filho (2001), an economic viability analysis evaluates a project proposal, leading to its acceptance or rejection.

According to the same author, there are three reasons why an economic viability analysis should be done in an ICT implementation project, namely:

- To support a possible implementation of the system;
- To identify the benefits and goals, keeping the ones in charge aware of the project objectives, so that they can be achieved;
- To identify the resources needed to implement the project, giving the power to ask for organizational commitment.

It appears that the economic viability analysis of a project is very important to an organization and should be used to support investment decision in order to minimize the risks of a wrong decision.

2.2 Supply chain and the food industry

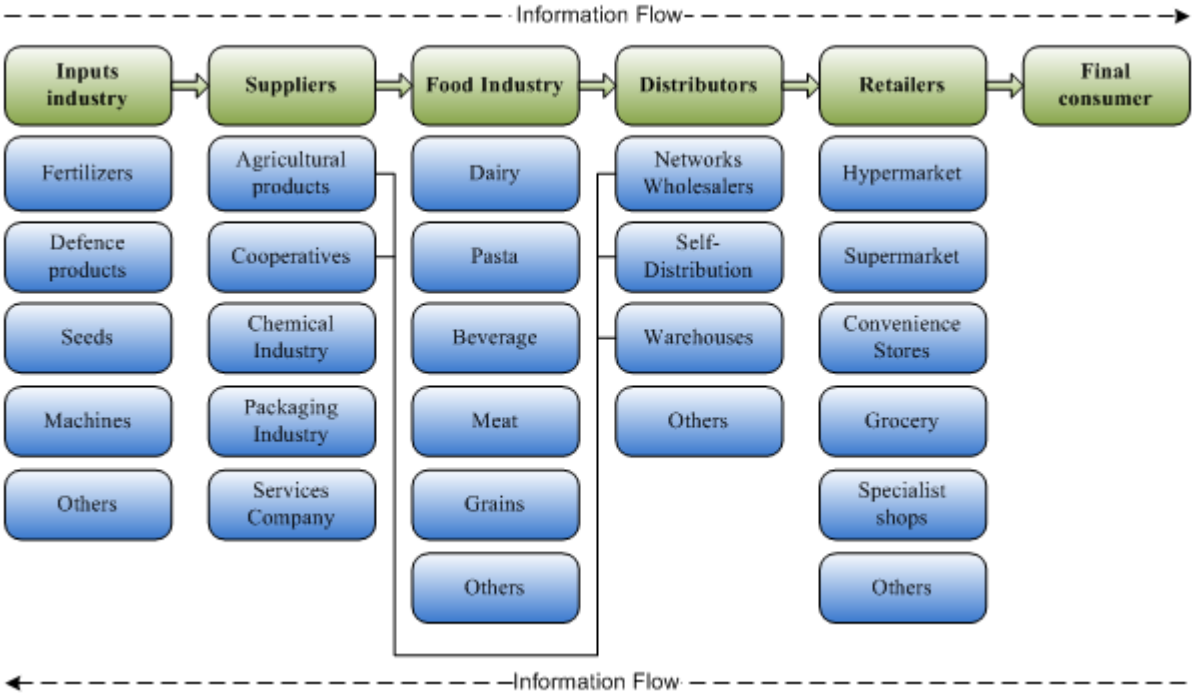
According to Gaither e Frazier (2002), a supply chain refers to the way that the goods flow through different organizations, starting with raw materials and ending with finished products to be delivered to final customers. It is a combination of suppliers, distributors, manufactures, customers and final customers.

The information flow is very important for the supply chain operations. The electronic information exchange provides an opportunity to reduce costs, to improve the service quality and to improve the information itself, due to a better coordination of network operations.

For Dias *et al.* (1997), a competitive strategy developed to capture and maximize the opportunities of supply chains demands that all the companies that are part of the chain work together, in perfect synchrony, using dynamic network structures. To achieve the perfect synchrony between the operations of a production network, many companies are using ICT's to gain benefits such as improvements in the communication channel with customers and suppliers, becoming more competitive. (LA ROVERE, 1999).

As we can see in Graphic 1, the supply chain in the food industry moves the product from the agro-business sector to the final customers. Considering that the food industry uses perishable inputs, the level of integration between the links of its supply chain is essential for its success, because the entire transformation process depends directly on the input quality.

The supply chain integration level is defined as the connection level between each operation of a network (LI *et al.*, 2002; WOOD, 1997; NARASIMHAN; JAYARAM, 1998). According to Lambert and Cooper (2000), the supply chain integration level depends on the number of management components in each link of the network, more components used, higher the supply chain integration level. The product flow structure and the information flow structure deserve to be highlighted, because they are critical components to the success of the food industry.



Graphic 1 – Production Chain in the food industry
Source: Prepared by the authors

Analyzing the benefits gained from the use of ICT's, such as more information exchange, cost reduction and faster communication; it appears that these technologies are very important for the supply chain integration of any company, leading to a more dynamic information flow and increasing the synergy between the operations of a network, highly contributing for the operation success.

3 Methodology

This article is considered to be a case study. Jung (2004) defines case study as being a research procedure that investigates a phenomenon in a real local context, especially when the boundaries between the phenomenon and the context are not clearly defined.

For Godoy (1995), the main characteristic of a case study is studying, in an intensive and detailed way, a well defined entity, that could be an organization, a process, a context, a group of people, a community etc…

In the business management field, the purpose of a case study is to present proper management practices used in the organizations. The description of a proper practice in a study allows the use of this information for similar situations, sharing the conquests achieved with other people or other firms, which can learn and reuse this information in other contexts.

In this article a study was carried out in order to analyze the importance of an economic viability analysis in ICT projects, and presents the use of ICTs to help the integration of a company's supply chain in the food industry. To achieve this goal was developed a study to analyze the economic viability of an ICT project, consisted of replacing a communication system based on phone line (system adopted by the analyzed company) for VoIP (*Voice on Internet Protocol*).

For the economic viability analysis, the costs of using either the phone line system or the VoIP system were measured, the data of the VoIP system implementation were collected and the profile to use this type of system was analyzed. The two methods used for data collection were:

- Interview: In this study three managers of the analyzed company were interviewed, and they informed the utilization pattern of voice communication technologies in the company. Using this method were collected data about the pricing plan used by the company, the approximate percentage of each phone call made(local phone call, long distance phone call, etc.) and the types of devices that the phone calls were directed to(fixed or mobile phones);
- Research on the Internet: To be able to do the economic viability analysis and the comparison between the two communications systems analyzed in this study, a research on the Internet about the prices of these services and the prices of the devices required to implement the VoIP communication system was carried out. This research consisted in accessing websites of the operators of the systems analyzed and online stores, and consulting the fares and the prices of the equipments required to implement the system.

After collecting data about the using and/or implantation of both systems costs, an economic viability analysis of the ICT implementation project was carried out and the results will be shown further down in this article.

4 The studied company

The company analyzed has been operating in the market for thirty-six years, producing guava and banana candies, and molasses. The company has twenty-nine employees and an annual profit of 55.046 dollars. It is located in the north region of Rio de Janeiro state and sells your goods in the entire Southeast Region of Brazil.

4.1 Identification and diagnosis of the problem

The problem presented in this article is the inefficient communication between the company and the other supply chain links, due to inappropriate communication systems used by the company.

The phone and the Internet are the main communication systems in the firm, and the telephone line is used to access the Internet. Due to the low speed dial-up Internet access, the Internet navigation is slow and the simultaneous use of the Internet and the phone is impossible.

The communication problem gets worse, considering the fact that the company is part of the food industry, dealing with perishable products and expensive conservation methods, which intensive the search for an integrated supply chain.

4.2 ICT Implementation Project

The solution found to the problem described in the previous section was the cancellation of the phone line and the utilization of a VoIP system with broadband Internet access.

The first benefit obtained with this project is the broadband Internet access, providing high speed Internet access for the company needs, such as checking e-mail, instant messaging and other services that the company might use.

The second benefit is the fact that the VoIP system is a low cost voice communication system. Calling other phones using VoIP, the company would pay extremely lower fares compared to the fares charged for regular phone calls, using the telephone line. Besides, phone calls between two computers using the same VoIP software are free of charge, which encourages the other supply chain links to computerize as well and enjoy the same benefits. A complete economic viability analysis of this project will be done in the next section.

One of the difficulties found in this article was the fact the firm is located in a suburb, where the broadband Internet access is not available**.** This obstacle was overcome with the discovery that there is sign of 3G mobile telephony of a company for mobile telephony called Claro, which enables Internet access with speed options ranging from 250 kbps to 1 Mbps, requiring just a USB modem.

5 The economic viability analysis of the project

5.1 Cost models for simulation

In this analysis, was adopted the 3G plan offered by Claro company with a speed of 1 mbps and unlimited Internet access for 46 dollars. The plans with lower fares were not considered for not meeting the requirements in terms of speed for the company. The VoIP software adopted in this study was Skype. The purchase of a local phone number is required in order to receive any phone calls from extern phones directly to Skype. The purchase of a local number can be done using the SkypeIn service for an annual fare of 37 dollars, and every time you make a phone call a US$ 0,04 fare will be charged to the company just once.

About the telephone line, the monthly fare is 19 dollars. The company uses the services of Telemar to make local phone calls and Embratel services to make long distance phone calls (using the Sim 21 Plan, that offers the same fares any time at all business hours). The table 1 lists the fares charged when using the telephone line and the Claro 3G system with Skype.

Type of call	Fare/minute	
	Skype	Telephone Line
Local phone call to local phone	US$ 0,04	US$ 0,05
Long Distance phone call to local phone	US$ 0,04	US$ 0,21
Local phone call to mobile phone	US$ 0,24	US$ 0,37
Long Distance phone call to mobile phone	US$ 0,24	US$ 0,79

Source: Website of the companies Embratel and Skype

Table 1 - Rates charged when using Skype and telephone line

The company managers informed the following data about the phone calls made:

– 70% of the phone calls are made to local phones, of which 80% are local calls;

- From the calls made to mobile phones, 90% are local calls;
- The company has an average of 1.300 calls per month, corresponding to an average of 3.600 minutes per month in calls.

Based on the Table 1 fares and on the distribution of the calls above, two models were developed to estimate the voice communication costs per month of the company using the two systems. The models described below show the variable costs depending on time of use (t).

Purchasing the telephone line plan, the company gains 200 minutes to make local phone calls to fixed line phones (FLP). Thus, a model was developed for FLP < 200 and for FLP $\geq$ 200 minutes.

For FLP < 200 minutes:

$$c(t) = 19 + (0{,}7 \times 0{,}2 \times 0{,}21)t + (0{,}3 \times 0{,}9 \times 0{,}37)t + (0{,}3 \times 0{,}1 \times 0{,}79)t$$

For FLP $\geq$ 200 minutes:

$$c(t) = 19 + (0{,}7 \times 0{,}8 \times 0{,}05)(t - 200) + (0{,}7 \times 0{,}2 \times 0{,}21)t + (0{,}3 \times 0{,}9 \times 0{,}37)t + (0{,}3 \times 0{,}1 \times 0{,}79)t$$

Resulting in:

$$c(t) = \begin{cases} 19 + 0{,}15t \text{ , se FLP} < 200 \\ 13{,}4 + 0{,}18t \text{ , se FLP} \geq 200 \end{cases}$$

Monthly cost with the Claro 3G and Skype:

$$c(t) = (1300 \times 0{,}04) + 46 + \frac{37}{12} + (0{,}7 \times 0{,}04)t + (0{,}3 \times 0{,}24)t$$

$$c(t) = 101{,}08 + 0{,}1t$$

5.2 Quantitative methods for financial analysis

5.2.1 Break-even point analysis

The break-even point occurs when the costs of both systems are equal in the utilization scale. Based on the costs models in the previous section, the differences between the costs of utilization of both systems were calculated. The results are shown in table 2.

Utilization Scale	Costs using Claro 3G and Skype	Costs using telephone line	Difference between systems
250	US$ 126,64	US$ 58,41	US$ (68,23)
500	US$ 150,72	US$ 103,13	US$ (47,59)
750	US$ 174,80	US$ 147,86	US$ (26,94)
1000	US$ 198,89	US$ 192,58	US$ (6,30)
1250	US$ 222,97	US$ 237,31	US$ 14,34
1500	US$ 247,05	US$ 282,03	US$ 34,98
1750	US$ 271,13	US$ 326,76	US$ 55,62
2000	US$ 295,22	US$ 371,48	US$ 76,23

2250	US$ 319,30	US$ 416,21	US$ 96,91

Source: Data calculated using the models in section 5.1

Table 2 – Costs difference depending on the utilization scale

As shown in Table 2, the cost reduction with the adoption of Claro 3G and Skype is proportional to the utilization scale of the system. The greater the utilization scale of the system, the more viable the 3G system with Skype compared to phone line system.

The cost models developed in section 5.1 were equaled to calculate the break-even point.

$$101{,}08 + 0{,}1t = 13{,}4 + 0{,}18t$$

$$t = 1096 \text{ minutes}$$

Analyzing the results, it appears that the adoption of the Claro 3G with Skype brings cost benefits to the company, when the utilization scale is over 1096 minutes per month.

Considering the total time spent in phone calls by the company (3600 minutes), the cost reduction expected with the implantation of the Claro 3G with Skype is approximately $ 208,38 per month, in addition to the benefits obtained from the broadband Internet access.

5.2.2 Payback Period Analysis

The payback period analysis consists in analyzing the time required to fully recover the entire capital invested in the project. The lower the payback period, the lower the risk of the project and sooner the capital is returned to be reinvested in another project. Below is the formula for calculating the payback period of the investment:

$$\text{Payback} = \frac{\text{Investiment (US\$)}}{\text{Cost Reduction (US\$)/month}}$$

Adopting the Claro 3G with Skype, the investment required is the purchase of a USB modem, which the Claro company sells in your online store from US$ 53,21; and also the purchase of a headphone with a microphone, with an estimated price of US$ 11,47, which leads to a total investment of US$ 64,68. Considering the cost reduction obtained with the implementation of this system, of US$ 208,38 per month, provided by the break-even point analysis, the payback period is:

$$\text{Payback Period} = \frac{\text{US\$ } 64{,}68}{\text{US\$ } 208{,}38 \text{ /month}} \approx 0{,}31 \text{ month}$$

It appears that the company will start with a deficit of US$ 64,68, which will be settled in the same month of implementation of the new system.

5.2.3 Net Present Value (NPV)

Net present value (NPV) is defined as the total present value of a time series of cash flows. Each cash inflow/outflow is discounted back to its present value. Then they are summed.

In this analysis, was considered a 11,75 % per year discount rate (0,98% per month), considering the country's annual basic interest rate (Selic). The NPV calculation (For a 6-month period) was performed as follows:

$$\text{NPV} = \frac{(64{,}68)}{(1{,}0098)^0} + \frac{208{,}38}{(1{,}0098)^1} + \frac{208{,}38}{(1{,}0098)^2} + \frac{208{,}38}{(1{,}0098)^3} + \frac{208{,}38}{(1{,}0098)^4} + \frac{208{,}38}{(1{,}0098)^5} + \frac{208{,}38}{(1{,}0098)^6}$$

$$NPV = 1143{,}79$$

The positive net present value of US$ 1.143,79 shows that the gains of the project cover the company's cost of capital, considering the rate of 0,98 % per month.

5.2.4 Present Value Index (PVI)

The Present Value Index is calculated dividing the present value of the inflows per the absolute present value of the outflows, being discounted.
In this analysis was considered the same rate used for calculating the NPV (Selic), of 11,75 % per year (0,98 % per month). The PVI calculation is done as follows:

$$PVI = \frac{206{,}35 + 204{,}35 + 202{,}37 + 200{,}40 + 198{,}46 + 196{,}53}{64{,}68}$$

$$PVI = 18{,}68$$

The PVI as a criterion of decision tells to accept all the projects that have an index greater than or equal to 1. In this case, the PVI is 18,68, meaning that the gains of the project are 18,68 times higher than the costs of investment in a 6-month period, adopting the discount rate of 0,98 % per month.

5.2.5 Internal rate of return (IRR)

The Internal rate of return is the discount rate at which the Net Present Value (NPV) is zero. This rate was calculated from the equation below:

$$\frac{(64{,}68)}{(1+i)^0} + \frac{208{,}38}{(1+i)^1} + \frac{208{,}38}{(1+i)^2} + \frac{208{,}38}{(1+i)^3} + \frac{208{,}38}{(1+i)^4} + \frac{208{,}38}{(1+i)^5} + \frac{208{,}38}{(1+i)^6} = 0$$

Using a computer algebra system, was calculated i = 3,2211, which is the internal rate of return (322,11 % per month). Interpreting this rate, it appears that the capital invested ($ 64,68) yields a compound interest rate of 322,11 % per month during the period considered (6 months).

An investment analysis tool is the comparization between the IRR and the minimum attractiveness rate (MAR). The MAR is a rate associated with low risk, in which an investor can invest and achieve financial returns.

In this analysis, the FA used was the Selic rate. Comparing the internal rate of return (322,11 % per month) with the Selic rate (11,75 % per year), it appears that the IRR is much greater than the MAR, concluding that the project is viable, according to this criterion of decision.

6 Final considerations

In this article, was presented the importance of the economic viability analysis for ICT implantation projects in a company from the food industry, to prove that was developed a case study comparing a VoIP system(Claro 3G with Skype) and a telephone line system(using Embratel with the plan Sim 21 plus).

The economic viability analysis was shown to be viable and a great decision-making support for decisions related to ICT implantation projects, avoiding the decision-making process guided only by the manager's intuition.

The implantation of the VoIP system was suggested to the company studied, considering the promising results obtained by the financial analysis methods, and also considering the benefits gained with the broadband Internet access.

It is important to emphasize that the company under study (as well as most of the companies within the food industry), works with perishable and seasonal inputs, with an expensive conservation process. The characteristics of these inputs allow the storage only for short periods, making the supply chain integration extremely important to the survival of the company. Thus, the major challenge of the integration is to make the inputs available and in suitable conditions for the production process. In this context, ICT's help expediting information flows in supply chains, bringing benefits such as faster information exchange and reduction of communication costs, being essential for a company to remain competitive in the market.

For future studies there is a possibility of obtaining interesting results out of similar studies analyzing other voice communication systems, including the adoption of other VoIP software, other services to access the Internet and different fixed phone plans. Another possibility is to use multicriteria methods to analyze not only the costs but a group of criteria that involve a new communication system implementation; and/or the utilization of the Real Options Theory to evaluate the risks that involve every decision during the analyzing and implantation process of the project.

To conclude, a meticulous project, and the use of methods that evaluate the risks and benefits of an investment, is essential for the success of ICT implementation projects, contributing to the achievement of successful technology projects.

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