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The works must be unpublished and refer to topics of General aggregative models: Marxian, Sraffian, Institutional, Evolutionary, Keynes, Keynesian, Post-Keynesian, Neoclassical, Forecasting and Simulation; Consumption, Saving, Production, Employment, and Investment: Consumption, Saving, Capital, Investment, Capacity, Production, Employment, Unemployment, Wages, Aggregate Factor income distribution, Forecasting and Simulation; Prices, Business fluctuations, and Cycles: Price level, Inflation, Deflation, Business fluctuations, Cycles, Forecasting and Simulation; Money and interest rates: Demand for money, Monetary standards and regimes, Government and the monetary system, Determination of interest rates, Term structure of interest Rates, Financial markets and the Macroeconomy, Forecasting and Simulation; Monetary policy, Central banking, and the Supply of Money and Credit: Money supply, Credit, Money multipliers, Monetary policy, Deposit insurance, Central banks and their policies; Macroeconomic-Aspects of public finance, Macroeconomic policy and general Outlook: Policy objectives, Policy designs and consistency, Policy coordination, Fiscal policy, Public expenditures, Investment, and Finance, Taxation, Comparative or joint analysis of fiscal and monetary or stabilization policy, Incomes policy, Price policy, Studies of particular policy episodes, General Outlook and conditions and other topics related to Social Sciences.

Presentation of Content

In a first article we present, *Technology and intellectual capital as part of the production process in companies in the city of Sucre*, by REYES-ORTIZ-SERRANO, Lucy Andreina & SALINAS-SANDI, Senit Ariane, with adscription at Universidad Mayor Real y Pontificia de San Francisco Xavier de Chuquisaca, in the next article we present, *Innovation processes in the companies of the city of Sucre: the influence of relational capital relational capital*, by SERRANO, Javier, MUJICA-ORTIZ, Skarley, MITA-ARANCIBIA, Erick and RENGEL-ARANCIBIA, Grissel, with adscription at Universidad Mayor Real y Pontificia de San Francisco Xavier de Chuquisaca, in the next article we present, *The levels of micro business production based on the phases of gypsum production through the descriptive method in District 2 of the Municipality of Sucre 2012*, by CHEZZI-DELGADO, Fabián, GUEVARA, Natalia, BORJA-RONAL, Subelza and WILBER-FRANZ, Choque Balcera, with adscription at Universidad Mayor Real y Pontificia de San Francisco Xavier de Chuquisaca, in the last article we present, *Comparative analysis of performance, cost and energy production between the isolated and interconnected system of the corrugated cardboard company Puebla S.A. de C.V.*, by FLORES, Oscar, GONZALES, Ricardo, JUAREZ, Victoria and HUITZIL, Ignacio, with adscription at Universidad Politécnica de Amozoc.

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Technology and intellectual capital as part of the production process in companies in the city of Sucre

Tecnología y capital intelectual como parte del proceso productivo en empresas de la ciudad de Sucre

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Abstract

This project rise to study the technological innovation and the use of intellectual capital in business in the city of Sucre. All manufacturing companies are taken into account in the city of Sucre, and it is sampled to measure how many of them take into account the intellectual capital, as a major part of their business and how the technological level. As well as the outline, how can they renovate their businesses? Furthermore, this research considers the primary information, such as: Historical Skandia models, to have a good foundation of what is intellectual capital (human)? Within companies how they will help them to business growth. Certainly, it is considered importance of technological innovation. Within companies and how it helps to possess market advantages over competitors. This research helps to visualize the state you are manufacturing companies of the city of Sucre.

Intellectual capital, Business, Sucre

Resumen

Este proyecto pretende estudiar la innovación tecnológica y el uso del capital intelectual en las empresas de la ciudad de Sucre. Se toma en cuenta a todas las empresas manufactureras de la ciudad de Sucre, y se muestrea para medir cuántas de ellas toman en cuenta el capital intelectual, como parte importante de su negocio y cómo el nivel tecnológico. Así como el esquema, ¿cómo pueden renovar sus negocios? Además, esta investigación considera la información primaria, como: Los modelos históricos de Skandia, para tener una buena base de lo que es el capital intelectual (humano) Dentro de las empresas cómo les ayudarán al crecimiento del negocio. Ciertamente, se considera la importancia de la innovación tecnológica. Dentro de las empresas y cómo ayuda a poseer ventajas de mercado sobre los competidores. Esta investigación ayuda a visualizar el estado en que se encuentran las empresas manufactureras de la ciudad de Sucre.

Capital intelectual, Empresas, Sucre

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† Researcher contributing first author.

Introduction

In a world of constant change, readjustment and social, political and economic openness, societies that have succeeded in building an efficient, stable and effective national innovation system, as well as achieving high levels of global competitiveness and well-being, thrive.

The transition from the 20th to the 21st century has framed a series of phenomena at the international level that suggest that our economies are going through a period of profound structural transformations. We are living through a new stage in world economic history (Jhon Naisbit Héctor Robles).

The information revolution is redefining our reality. Information technology transforms the way goods and services are produced and distributed. Its degree of penetration in society is not homogeneous, but the changes it generates are becoming more evident every day. Today it is increasingly common for companies to have computers to operate their processes; it is also more common for people in big cities to carry a laptop computer in their briefcase. Supermarket cash registers are replaced by more sophisticated equipment including an optical reader and a computer terminal. Organisational and procedures manuals, once recorded on paper, are now in bits. We could give many more examples, but what is a fact is that information technology has impacted the business world; its potential offers new ways of operating that enable organisations - if they use it properly - to achieve high levels of productivity and competitiveness.

Background

Since World War II, the output of economic activity or Gross Domestic Product (GDP) in some countries began to depend less on the transformation of the physical basis of production, i.e. objects (matter and energy transformed into manufactured products) and more on the transformation of the intellectual basis of production, i.e. the representations of objects.

In a certain way, technology is the product or result of the generation of knowledge, knowledge in turn implies a socio-cultural construction, with particular characteristics, especially in the prevailing global circumstances.

These circumstances stand out for the ethical and legal rupture in the management of techno-scientific power, in the midst of a largely recolonising globalisation, as well as the most complex and immoral of connections between domination, mass extermination and technological development.

In Latin America, the issue of endogenous technological development acquires a broad ideological nuance, due to the profound structural crisis derived from a failed development model, which necessarily forces us to look to techno-science as a valuable support in the achievement of social peace, as a fundamental ingredient for the construction of a humanist development model.

The social acceptance of technological innovations is linked to their benefits, as well as to the possibility of guaranteeing a sustained improvement in the quality of life. Thus, the social impact of technological innovations, measured only in terms of the market, is a tremendous mistake, especially when we talk about our national reality, a clear result of the constant deterioration in the terms of trade, which accompanies and "legitimises" our participation in the world economy. (Elsa Beatriz Acevedo Pineda).

Innovation is not only important to obtain productivity gains and improve the international competitiveness of our companies and products; it is also the guarantee to increase the standard of living of the whole society and to improve the functioning of all types of institutions, both in their economic and extra-economic aspects (Antonio Pulido,2005).

In the new pattern of competition, competitive advantages based on knowledge and technology predominate, while comparative advantages based on factor endowments lose importance. In the past, financial and natural capital were the main sources of advantage, today it is human capital and knowledge. The technological revolution and the development of knowledge as a decisive force in the economy are taking hold. One of the fundamental characteristics of today's global economy is the growing interdependence between the capacity to generate scientific and technological knowledge and the creation of wealth. The trend is for this association to become ever stronger.

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Thus, we are facing a transition from a system based on mass production for direct consumption and export to one of product differentiation and competitiveness based on technological and institutional innovation capabilities. As a consequence, we see a drop in the prices of primary products and commodities and a higher valuation of value-added products.

Innovation, and particularly innovation in technology, becomes a key factor in raising productivity, but it is also very important for forging new opportunities, associated with quality improvement, harvesting timeliness, preservation and processing. The nature of competition in global agribusiness is increasingly based on the value added and technological knowledge incorporated into agricultural products.

From a more general perspective, innovation also plays a crucial role in overcoming the ecological and climatic threats and constraints arising from human expansion, as well as the serious problems of poverty and social equity in developing countries, both of which are closely related to agricultural issues.

As a consequence of the increased importance of innovation for agriculture and agribusiness, there has been an increase in the total amount of investment in agricultural R&D in the world in recent decades, with a growing proportion of it coming from the private sector.

If one turns to statistics to analyse the country's position in terms of innovation and research in science and technology, the results are alarming. A recent study by the Ibero-American Science and Technology Indicators Network (RICyT), which evaluated investment in S&T in the region compared to that in other parts of the world, concluded that global investment is divided as follows: USA and Canada contribute 43%, the European Union 25%, Japan 16%, the rest of Asia 10%, the rest of the world concentrates 4% and Latin America and the Caribbean occupies 1.9%. On the other hand, the study highlights that in Europe scientific investment is of the order of 1.81% of its GDP, in the US it is 2.70% and in Japan it exceeds 3%.

Meanwhile, in Latin America and the Caribbean, only 0.59% is reached in the year 2000, an average that is basically sustained by Brazil, with Peru lagging behind with 0.08% (3.5 times less than Bolivia). Another important fact provided by RICyT is that in the 1990s investment in S&T in Latin America increased from 0.39% to 0.59% of GDP, highlighting the efforts made by Brazil, Costa Rica, Cuba and Chile, which have a proactive S&T policy2. (www.inia.gob.pe/ September 2011).

Intellectual capital (IC) has become an essential factor for the survival of organisations and the ongoing development of companies (Juma, 2004). IC offers a potential source of sustainable competitive advantage and competence; the valuation of intellectual capital is important as it demonstrates how the firm aligns with its long-term strategic vision (Hayton, 2005, Sveiby 2000). Youndt (2005) refers to IC as the ability to influence innovation within organisations, Roslender (2004) states that intellectual capital is related to the topics of intangibles, innovation and knowledge.

The increased effectiveness and generation of innovation comes from the possession of knowledge by workers, a vast number of these developments have not been measured consistently or evaluated correctly due to the lack of standards for measuring such innovations in the workplace, which means that society has difficulty in identifying and diffusing them as quickly as possible without being able to detect their effects on the productivity of companies (Shaw, 2005).

Based on the aforementioned research it is presumed that intellectual capital can be considered as a strategy of organisations, especially the personnel related to innovation, in order to make the company more effective and more competitive.

The present research aims to find the relationship that exists between the organisation's IC and the effectiveness of the technological innovation process in companies in the city of Sucre, identifying the characteristics of the factors that translate into experiences, knowledge, development of skills and abilities that generate innovations within the organisation that can help to increase its effectiveness in the market.

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Materials and methods

The following methods will be used in this work:

- Bibliographic. The necessary literature review will be carried out.
- Historical. Data will be collected over time.
- Analytical. Each piece of information and phenomenon will be analysed in detail.
- Inductive. General conclusions will be drawn from each part analysed.

Materials and methodology

The following techniques will be used:

- Interviews: This will be carried out with the managers of the companies analysed or with people who are decisive for the work to be carried out.
- Surveys: They will be addressed especially to the personnel of the companies analysed.
- Measurement: Directly aimed at the quantitative and qualitative data obtained.

Results and discussion

The results obtained from the surveys and interviews carried out in the different companies are shown below in tables and charts.

Results obtained

Figure 1 Company statistics

This table shows all the characteristics of the companies, such as the size of the company in the city of Sucre, which is characterised by being small (3%), medium-sized (12%) and others (2%), the ease of work (13% simple and 7% complicated) and finally the use of intellectual capital in the companies (12% yes and 2% no).

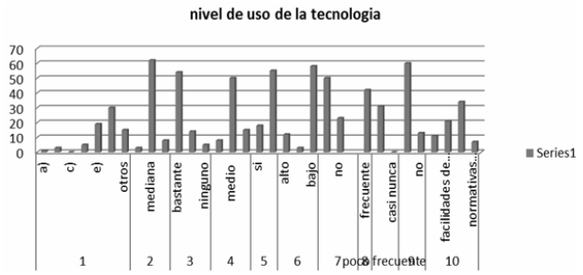

Figure 2 Level of use of technology

In this graph we can see data on the use of technology in the enterprises of Sucre such as the level of importance of the technologies inciso 1(d) very important, the size of the enterprises 2(medium), human capital 3(quite a lot), production level 4(medium), new technology 5(no), export level 6(low), more production at local level 7(yes), innovation in enterprises 8(frequent), training of personnel 9(yes), requirements 10(payment and credit facilities).

Discussion

The enterprises in Sucre are characterised by being medium and small enterprises, the majority of which use old technology with some innovations, and intellectual capital is generally used in innovations to bring out new products and not in the use of new machinery.

Conclusions

It can be verified that the companies in the city of Sucre are based on medium and old technology, this is because there are no good incentives from the government and also because buying new machinery has a very high cost. And the intellectual capital has a great importance in all the interviewed companies since it is a fundamental part of their growth, so it can be said that the only thing that is missing is a little more training in new technologies and this would help to improve and thus to achieve a greater competition against other cities and why not say other countries, and in this way to advance to the next step which is the industrialisation of our products.

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By means of the present document we show our best wishes to contribute to the country in the improvement of our productive processes.

We are also very grateful for the wisdom that God gives us at every moment, to our parents who are the guide and the values instilled in us day after day.

Thanks to the people who collaborated with the information for this work and to all the people who opened their doors to us to conduct the interviews.

We hope that this document will be a guide for people who want to be informed about intellectual capital and technological innovation in our city.

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Innovation processes in the companies of the city of Sucre: the influence of relational capital relational capital

Procesos de innovación de las empresas de la ciudad de Sucre: la influencia del capital relacional

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Abstract

This paper is an empirical study of descriptive-causal. It aims to determine the degree of relationship between the establishment of a relational capital, understood as those partnerships, relationships or links between the company, its suppliers, competitors and the institutional sector in which it is immersed and innovation processes thereof. These processes include the design innovation of products / projects and / or services in conjunction with environmental actors and institutional image also achieved from a reputation for innovation. Therefore, this study focuses on two types of variables: innovation (dependent variable) and relational capital (independent variable). To measure each of these variables were formed several items that were reduced in number through the factor analysis. In order to measure the degree of relationship between these two variables was obtained Pearson correlation coefficient, obtained as the value 0.37, which means that there is a positive relationship between these two variables but unfortunately a relatively low degree of association because only 37% of the innovation processes of firms is explained by the formation of alliances or relationships with their business environment.

Relational capital, Innovation, Business environment

Resumen

Este trabajo es un estudio empírico de tipo descriptivo-causal. Pretende determinar el grado de relación entre el establecimiento de un capital relacional, entendido como aquellas asociaciones, relaciones o vínculos entre la empresa, sus proveedores, competidores y el sector institucional en el que está inmersa y los procesos de innovación de la misma. Estos procesos incluyen la innovación en el diseño de productos/proyectos y/o servicios en conjunto con los actores del entorno y la imagen institucional que se logra también a partir de una reputación de innovación. Por ello, este estudio se centra en dos tipos de variables: la innovación (variable dependiente) y el capital relacional (variable independiente). Para medir cada una de estas variables se formaron varios ítems que se redujeron en número mediante el análisis factorial. Para medir el grado de relación entre estas dos variables se obtuvo el coeficiente de correlación de Pearson, obteniéndose como valor 0,37, lo que significa que existe una relación positiva entre estas dos variables, pero lamentablemente un grado de asociación relativamente bajo ya que sólo el 37% de los procesos de innovación de las empresas se explica por la formación de alianzas o relaciones con su entorno empresarial.

Capital relacional, Innovación, Entorno empresarial

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† Researcher contributing first author.

Introductionn

The changing and highly competitive environment in which businesses now find themselves has highlighted the concept of innovation as one of the main drivers of business competitiveness and livelihoods.

Innovation is the ability to take new ideas and convert them more efficiently and faster than the competition into business results through new processes, products or services (European Commission, 2009 in Noanilles, 2009:11).

Initially, these ideas can be generated within each company, but they can also be generated outside its borders, i.e., through contact with actors in its environment when companies do not have their own internal resources and capabilities.

Innovation is therefore related to much more complex out puts, going beyond the technological dimension and also encompassing intra and inter-firm policies and processes emerging from networks of economic, cognitive, coordination and cooperation relations, among others that companies can set up for mutual benefit.

In this sense, companies can integrate networks of social relations (stake holders), inter-company (customers, suppliers), institutional (chambers of commerce, university, city hall), that is to say, a relational capital that facilitates or aims to generate initiatives to obtain new products, services, processes, of various kinds whose results allow them to be more competitive in their markets.

In this understanding, this paper uses the concept of relational capital provided by the relational approach derived from the resource-based theory (Penrose, 1959), understood as the set of intangible assets that have a positive value for the organisation [...] relational capital is a source of competitive advantage and concerns the links between the company, customers, suppliers, investors, partners, i.e., the company's network (Dumoulin, 2010:19).

We assume in principle that each company has instinctively or premeditatedly developed a certain relational capital, which has a positive influence on its innovation processes (Porter, 1999; Martin de Castro, 2009, 2010) and that thanks to the formation of this relational capital, these innovation processes are not only promoted but also accelerated.

Background

Many studies on the concept of innovation have focused on the supply of "novel" end products or services by considering the individual firm in isolation from its competitors and in isolation from its collaborative environment.

These studies have tried to look for concise and tangible results on the expressions of innovation based mainly on the introduction of new technologies to the market, certainly in highly competitive markets (Higth Tech).

However, the establishment of social networks of cooperation and collaboration in which companies support and use each other to establish innovation processes has been very little studied in the business environment of the city of Sucre.

One of the studies about the innovation of companies in the city of Sucre outside the boundaries of the organisations was developed by Mita et al (2009). Within the framework of the academic institutional environment, it found that the links of research and development processes generated at the University of San Francisco Xavier de Chuquisaca with companies is very low.

The authors found that only 82% of companies in the industrial sector undertake innovation processes, followed by companies in the commercial sector (70%) and services (61%); the university contributes to these innovation processes in the following percentages: to the industrial sector 20%, services 27% and commercial 15%.

This study also shows that since innovation is a process over time, it requires endogenous elements (company capacities) and exogenous elements (external actors) that promote effective development.

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Materials and methods

Type of research

This research is an empirical study using a causal-descriptive research design.

This type of research made it possible to establish the components of the variables under study and the type of relationship existing between them, measured by means of the correlation coefficient.

Selection and definition of the collection instruments

The main collection instrument used was the survey, aimed at managers, owners or senior executives of small businesses in the city of Sucre.

The survey was made up of different indicators obtained from the bibliographical review that characterise on the one hand the relational capital and on the other hand the different innovation processes/projects/products and/services that we have called innovation achievements. The characterisation of these two variables made it possible to establish levels of influence through correlation analysis.

For the analysis of quantitative data, the SPSS V. 15 statistical package was used, proposing a multivariate analysis (factor analysis) for the reduction of sub-variables that make up both relational capital and innovation achievements and the determination of the correlation coefficient to measure the degree of relationship between the variables under study.

Freddy Gallardo, Head of the Administrative-Economic Unit of the Federation of Private Entrepreneurs of Chuquisaca.

In addition, secondary sources of information (specialised articles) were consulted to complement the collection of statistical information.

Definition of the target population

The population was defined in the following terms:

Poblacion objetivo	Marco muestral	Tipo de muestreo
Unidad: pequeñas empresas de la ciudad de sucre con cinco o más años de vigencia en el mercado y con un número de 10 a 40 empleados **Elemento:** gerente o alto ejecutivo de la pequeña empresa **Extensión**: área urbana de la ciudad de sucre **Tiempo:** gestión 2012	Listado de empresas inscritas en la cámara de industria y comercio de chuquisaca	No probabilistico por Juicio

Table 1 Definition of the target population

Criteria for the selection of the small enterprises under study

The Vice-Ministry of Micro and Small Enterprises considers as small enterprises those economic units with a number of employees between 10 and 49 employees. The present study considers small enterprises (and not Mypes for example), which have this range of employees based on the empirical study developed by G. Martin et al (2009: 91) in which it is proven that the higher the human capital of a company, the higher its innovation capacity. The length of time in the market was also another selection criterion, as years in the market allows for the development of a culture of innovation and links with the environment that recent initiatives do not achieve.

Determination of the sample

Based on the identification of the target population, the following table shows the number of companies that meet the selection criteria of having 10 or more employees and five years of activity considered for this study:

Detalle	N° de pequenas empresas registradas
Número de empresas correspondientes al sector industrial	74
Número de empresas que corresponden al sector comercial y de servicios	204
Total	278

Table 2 Number of companies affiliated to the chamber of industry and commerce

Therefore, the sample for the present study consisted of the following:

Detalle	N° de pequenas empresas registradas
Empresas correspondientes al sector industrial	9
Empresas correspondientes al sector comercial y de servicio	18
Total	27

Table 3 Number of surveys administered

Results and discussion

For the development of this chapter and in order to verify the hypothesis set out at the beginning of this research, we proposed the following work scheme, following the methodology proposed by Martin de Castro *et al*.

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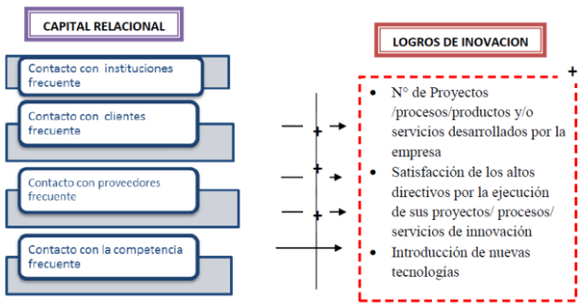

Figure 1

Characterisation of the small enterprises under study

In general terms, the SME sector (small and medium-sized enterprises) in Bolivia represents about 5 % of the total number of economic units, provides approximately 9 % of private employment, and the sector's contribution to the Bolivian GDP is around 8 %.

The contribution to the national economy is lower than the social contribution due to the technological and infrastructure conditions in which the SME sector operates, the type of its products and services and the volumes of capital at its disposal (Banco Bisa Pyme, 2012).

For the purpose of this research, only those companies that have been operating in the city of Sucre for at least five years and that have between 10 and 49 employees were considered, since otherwise it would be assumed that they are micro or large companies (Banco Bisa Pyme, 2012).

The following tables summarise these two criteria for the selection of the enterprises under study:

		Tiempo en el mercado			
		De 5 a 10 años	De 11 a 16 años	De 17 a más años	Total
Sector :	Comercial	5	1	2	8
	Industrial	1	2	1	4
	Servicios	2	6	7	15
Total		8	9	10	27

Table 4 length of time on the market according to sector

		Numero de empleados				
		De 10 a 15	De 16 a 21	De 21 a 27	De 27 a 49	Total
Sector:	Comercial	5	2	0	0	7
	Industrial	1	1	0	2	4
	Servicios	8	0	1	6	15
Total		14	3	1	8	26

Table 5 Composition according to number of employees by sector

The above tables confirm that SMEs in the city of Sucre are mainly made up of service enterprises, since 58% (15 enterprises) of the enterprises participating in the study belong to this sector. The service sector also concentrates those enterprises that have managed to remain in the market for the longest time.

Analysis of the existing relational capital in companies

Based on the review of the literature in this section, we will consider only three types of relationships that companies establish and on which relational capital originates, develops and/or strengthens. These four relationships are: contact with customers, with suppliers, with competitors and with institutions in the sector (Martin de Castro, 2009).

Factor analysis - Relational capital

In order to be able to measure these relationships, a set of questions were developed, which were reduced through factor analysis due to the large number of questions. This multivariate analysis has the function of reducing a large number of items to specific factors. This table summarises the different items considered in the factor analysis to measure relational capital:

Indicadores de medicion	Items considerados en encuesta
Medicion de la relacion con clientes	Los contactos con los clientes son bastante cercanos Por lo general, las relaciones con nuestros clientes es a largo plazo
Medicion de la relacion con proveedores	Nuestros empleados toman contacto con proveedores para solucionar problemas en común; En nuestra empresa las alianzas obtenidas con proveedores e instituciones tienen solidez Por lo general, las relaciones con nuestros proveedores es a largo plazo Nuestra empresa tiene habilidad para establecer alianzas
Medicion de la relacion Con instituciones	Los contactos con las instituciones que apoyan a nuestro sector es cercano La emp. Guarda mucho mas contacto con instituciones que con competidores o clientes
Medicion de la Relacion con la Competencia	Nuestra empresa prefiere mantenerse completamente alejado de la competencia Los contactos con nuestros competidores es bastante cercano

Table 6 Relational capital measurement indicators

In general terms, and in order to know the specific results per question, the following table summarises the measures of central tendency per question consulted:

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		Los contactos con los clientes son bastante cercanos	Los contactos con nuestros competidores es bastante cercano	Nuestros empleados toman contacto con proveedores para solucionar problemas en comun	Los contac con las institucion que apoya nuestro sec es cercan	Por lo genera l, las relacio nes con nuestr os cliente s es a largo plazo	Por lo general, las relacione s con nuestros proveed ores es a largo plazo	La emp. guarda mucho mas contacto con instituciones que con competidores o clientes	En nuestra empresa las alianzas obtenidas con proveedores e instituciones tienen solidez	Nuestra empresa tiene habilidad para establecer alianzas	Nuestra empresa prefiere mantenerse completamente alejado de la competencia
N	Validos	27	27	27	27	27	27	26	27	26	27
	Perdidos	0	0	0	0	0	0	1	0	1	0
Media		1,85	2,78	2,52	2,59	1,93	2,07	3,00	1,93	1,92	3,11
Mediana		2,00	3,00	2,00	2,00	2,00	2,00	3,00	2,00	2,00	3,00
Moda		**2**	**2**	**2**	**2**	**2**	**2**	**4**	**2**	**2**	**3**

Measurement scales: 1=Strongly agree, 2=Agree, 3=Neutral, 4=Disagree and 5=Strongly disagree

Table 7 Measures of central tendency obtained from the indicators for measuring relational capital

As can be seen, the responses of the surveyed companies are between the value of totally agree for the indicator of valuation of the relationship with clients, as well as the relationship with suppliers at company level. However, the responses regarding contact with competitors appear to be neutral, which gives an indication that contact with competitors is still low.

To assess the relevance of the exploratory factor analysis applied to the set of items previously mentioned, we proceeded to obtain the different tests that make up the factor analysis (see Annex N° 3):

Indicadores utilizados para El analisis factorial	Resultados	Verificacion
Determinante de la matriz de correlaciones	0,13	Mayor a 0,1
Test de KMO (Kaiser-Meyer-Olkin)	0,714	Debe ser superior a 0,7
Test de esfericidad de Barlett	0.000	Debe tener un nivel de Significación igual a 0,000

Table 8

Having checked the relevance and veracity of the factor analysis (KMO >0.7), we proceeded to name the different factors on the basis of the items that made them up. The following table summarises the results obtained:

Nominacion por factor	Items considerados según analisis factorial
Factor n°1: *capital relacional a todos los niveles*	Los contactos con los clientes son bastante cercanos
	Los contactos con nuestros competidores es bastante cercano
	En nuestra empresa las alianzas obtenidas con proveedores e instituciones tienen solidez
	Por lo general, las relaciones con nuestros clientes es a largo plazo
	Por lo general, las relaciones con nuestros proveedores es a largo plazo
Factor n°2: *capital relacional institucional*	Los contactos con las instituciones que apoyan a nuestro sector es cercano La empresa guarda mucho más contacto con instituciones que con competidores o clientes
Factor n°3: *capital relacional solo con proveedores*	Nuestros empleados toman contacto con proveedores para solucionar problemas en común. Nuestra empresa tiene habilidad para establecer alianzas
Factor n°4: *capital relacional alejado de competencia*	Nuestra empresa prefiere mantenerse completamente alejado de la competencia

Table 9 Ranking of items by factor

Analysis of the identified factors

Factor N°1: Relational capital at all levels, this identified factor shows how companies have relationships not only with the components of the value chain to which they belong, i.e. customers and suppliers, but also with a much broader spectrum that includes the institutional environment in which they operate, as well as with the competition. Undoubtedly, this level of relational capital achieved is much more solid, it allows the company to know more closely the dynamism of the market and to face it with innovative products, services and/or processes that guarantee its permanence in the market.

Factor N°2: Institutional relational capital, this factor corresponds to those companies in which only the institutional framework governs the spectrum of their relations, as relations with suppliers and clients are circumstantial and therefore not sustainable over time. This factor also does not take into account the competition when developing their activities in the market.

Factor N°3: Relational capital only with suppliers, this factor overvalues the supplier-company dyad. Therefore, the production chain is neither fully exploited nor exploited. The relationships in this case may be sustainable in the long term with suppliers but the permanence of the company in the market is at risk because the relationships with the client are not taken care of.

Likewise, these companies may not be favoured by advances made at the sector level, since they are not particularly inserted in the institutional sphere and competition is also excluded from the analysis of these companies.

Factor N°4: Relational capital distanced from the competition, this factor maintains a certain relational capital since it maintains a relationship with clients, suppliers and institutions that are part of its activity, but the competition is excluded. This phenomenon can be seen in highly competitive markets where it is not possible to establish real alliances or where such alliances are regulated under the risk of commercial lobbying or oligopolies. However, for a true development and exploitation of relational capital towards the creation of value for companies, it is important to consider and analyse competition.

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Analysis of the innovative component of companies

The following is the nomination of the items considered in the survey to measure the level of innovation achieved by the companies (which we call "innovation achievements").

Logros de innovacion	Items considerados en encuesta
Número de nuevos proyectos/procesos productos y/o servicios desarrollados por la empresa	El número de productos/servicios/proyectos que hemos realizado en los últimos tres años es superior al competidor más cercano Respecto a nuestro competidor más cercano el número de nuevas tecnologías desarrolladas en los últimos tres años es superior
Grado de satisfacción de los directivos con proyectos/procesos/productos y/o servicios d innovación	El grado de satisfacción de nuestra empresa por la eficiencia de los proyectos de innovación es elevado Nuestra empresa tiene una reputación superior a sus principales competidores debido a su alto nivel de innovación
Número de Tecnologías desarrolladas recientemente por empresa	Nuestros últimos procesos y/o servicios/productos tienen un elevado componente tecnológico

Table 10 Items for measuring innovation achievements

As in the case of relational capital, in the following table we present the measures of central tendency, obtained by question consulted. We will focus primarily on the mode as it is a qualitative variable.

		Nuestra empresa posee un importante número de clientes	El grado de satisfacción de nuestra empresa por la eficiencia de los proyectos de innovación es elevado	En nuestra empresa el índice de quejas de clientes es bastante reducido	La calidad de los productos/servicios de nuestra empresa es ampliamente reconocida en el mercado	Nuestra empresa tiene una reputación superior a sus principales competidores debido a su alto nivel de innovación	Respecto a nuestro competidor más cercano, el número de nuevas tecnologías desarrolladas en los últimos 3 años es superior	Muchos de nuestros procesos de innovación dependieron del contacto o con la competencia o con instituciones del sector	Nuestros últimos procesos y/o servicios/productos tienen un elevado componente tecnológico
N	Validos	27	27	27	27	27	27	27	27
	Perdidos	0	0	0	0	0	0	0	0
Media		1,41	2,04	2,04	1,59	1,89	2,19	2,81	2,63
Mediana		1,00	2,00	2,00	2,00	2,00	2,00	3,00	2,00
Moda		1	2	2	1	2	2	2	2

Scales of measurement: 1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree and 5=Strongly Disagree.

Table 11 Measures of central tendency of the innovation achievements of enterprises

We now proceed to the nomination of the factors identified for the innovation achievements variable:

Nominacion por factor	Items considerados según analisis factorial
Factor N° 1: empresas innovadoras	El número de productos/servicios/proyectos que hemos realizado en los últimos 3 años es superior al competidor más cercano
	Nuestra empresa posee un importante número de clientes
	El grado de satisfacción de nuestra empresa por la eficiencia de los proyectos de innovación es elevado
	La calidad de los productos/servicios de nuestra empresa es ampliamente reconocida en el mercado
	Nuestra empresa tiene una reputación superior a sus principales competidores debido a su alto nivel de innovación
	Respecto a nuestro competidor más cercano, el número de nuevas tecnologías desarrolladas en los últimos 3 años es superior
Factor N° 2: empresas eficientes	En nuestra empresa el índice de quejas de clientes es bastante reducido
Factor N° 3: empresas movidas por la innovación tecnológica	Nuestros últimos procesos y/o servicios/productos tienen un elevado componente tecnológico

Table 12 factors identified from the innovation achievements

Factor N°1: Innovative companies are those companies that implement innovation processes at different levels, processes, products, services and/or projects. They know that they are superior to the competition precisely because of the development of these innovative processes and as a consequence they also have a considerable customer base.

Factor N°2: Efficient companies, these are companies where the achievements of innovation are not visible, they are satisfied with their work as measured only by the fact that the number of customer complaints is almost non-existent.

Factor N°3: Companies driven by technological innovation, according to the classification made by Shumpeter (1970) for these companies innovation is only presented through the introduction of Tics that can speed up the provision of services or products to the market.

Verification of hypotheses

In order to verify our initial hypothesis, we proceed to calculate Pearson's correlation coefficient which measures the percentage of the independent variable explained by the dependent variable.

		Capital relacional a todo nivel	Empresas innovadoras
Capital relacional a todo nivel	Pearson Correlación	1	**,372**
	Sig. (2-tailed)		,056
	N	27	27
Empresas innovadoras	Pearson Correlación	**,372**	1
	Sig. (2-tailed)	,056	
	N	27	27

Table 13 Correlation analysis between relational capital at all levels and innovative firms

As the bivariate analysis shows, the factor called relational capital at all levels, i.e. relationships with suppliers, customers, competitors and institutions, has in the first instance a positive relationship (i.e. if one of the variables increases, the other increases as well) on the achievements of innovation, i.e. on the development of products/services, innovation processes, thanks to which their business image is enhanced as well as their customer base. Another type of interpretation we could assume is that 37% (0.372) of the innovation achievements of the companies are due to their existing relations with their environment.

Processes, products/services developed in the last three years

In order to complement the above information, we present below the number of projects, processes, products/services developed in the last three years by the companies considered to be innovative.

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	Como empresa	En alianzas con otras empresas no competidoras	En alianza con la competencia	En alianza con instituciones del sector
N° de procesos desarrollados en los últimos 3 años	69	24	5	28
N° de productos/servicios desarrollados en los últimos 3 años	129	22	17	6
Total	198	46	22	34

Table 14 Processes, products/services developed in the last three years

As the table above shows, many of the innovation initiatives are internal to the company. In order of priority are alliances with competing companies, followed by the institutional sector, consisting mainly of institutions such as the municipal government and chambers of commerce.

According to Freddy Gallardo, head of the economic analysis unit of the federation of private businessmen of Chuquisaca, the business sector does not find it attractive to join a chamber, as they do not perceive concrete benefits from this affiliation and, on the contrary, it is onerous.

Alliances between competing companies are not yet evident, and it seems that in this sense, companies are wary of dealing with market rivals on products or services that could benefit them both.

Perception of the concept of innovation and the role played by relational capital

Finally, small enterprises in the city of Sucre were asked about their perception of innovation and the role played by the establishment of relational capital:

N°	Concepto de innovacion	Se logra gracias a …	Importancia de clientes/proveedores
1	Primordial	La experiencia y desarrollo tecnológico	Necesario para mantener su liderazgo
2	Avanzar con las exigencias del mercado	La identificación en diferentes sectores	Un pilar de la estructura de funcionamiento
3	Una dinámica de cambio	Los clientes	Valiosos
4	No responde	No responde	No responde
5	Perfeccionamiento / progreso	Creatividad y trabajo comprometido	De vital importancia
6	Mejorar constantemente	Adquisición de insumos agricolas de mejor calidad	Cercano y confiable
7	Tecnología	La economía	Bueno
8	Buscar productos de bien	Apoyo de información	Bueno
9	No responde	No responde	No responde
10	Importante	Planificación	Importante
11	Mejores productos y servicios para una mejor satisfacción	Nueva tecnología y globalización	Muy buena
12	Desarrollar nuevas tecnologías	Las inversiones logradas por la misma empresa	Constante
13	Meta primordial	Capacidad tecnológica	Más cercana
14	Estar siempre actualizados	Investigaciones	Lo primordial
15	Un proceso	Desarrollo	Muy normado
16	No responde	No responde	No responde
17	Ofrecer equipo de última tecnología	Eficiencia trabajo en equipo	Importante para lograr nuestros objetivos
18	No responde	No responde	No responde
19	Tecnología	Los productos que se ofrece	Mercado
20	Lo desconocido para la competencia	Desarrollo y logro de objetivos	Parte fundamental de la innovación
21	Mejora constante en los modelos de negocio	Cambios organizacionales tecnológicos, misión y visión	El que debe motivar impulsar y alimentar estos cambios
22	Tecnología	Una gran inversión	Necesario para mantener su liderazgo
23	Mejoras en procesos	Una capacitación permanente	Muy importante
24	Hacer de manera diferente para mejorar	Arduo trabajo en i y d	Fundamental
25	Estar por delante de la competencia	Contacto con otras empresas	Bueno
26	Mejora constante	Controles y mediciones constantes	L a variable principal
27	Ampliar y mejorar el servicio	Los recursos humanos y la tecnología	Muy importante

Table 15 Perception of the enterprises with respect to innovation and its promotion based on the formation of relational capital

As can be seen from the total number of responses obtained, for 41% of the companies, the concept of innovation is linked to making continuous improvements, and therefore alludes to the dynamism that every company must have in the market in which it operates. Likewise, the concept of innovation for 18.5% of the companies is linked to technology, but as Boldrini J.C. and Chéné (2011) point out, innovation in the vast majority of cases goes beyond the technological component.

Discussion

We have empirically demonstrated that the fact of establishing relationships and alliances with actors in the environment in which the company is inserted has a favourable impact on the innovation processes of small companies in the city of Sucre, as proposed by Dyer and Sigth (1998). The companies consider it important and fundamental to generate innovation processes but prefer to manage them internally, and mistrust regarding the loss of knowledge, skills and even human resources may be a factor in this mistrust. Despite the fact that the companies under study are not part of highly competitive markets such as High Tech, for example, where patent protection and the activity itself is highly regulated. Despite the fact that alliances are more in favour of alliances with suppliers (i.e., down the value chain), these do not seem to have a significant impact on the innovation processes of the companies, given that most of them still manage their processes independently.

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The institutional sector, as in the case of the Federation of Private Entrepreneurs of Chuquisaca, serves as a spokesperson for needs; the gestation of solutions to sectoral problems is carried out within chambers that are integrated by sector.

Limitations and future research

The present study is subject to several limitations in the analysis of concepts that, due to time constraints, could not be implemented. For example, the absorptive capacity of firms is not considered, i.e. the ability of the firm to apply (Cohen and Levinthal, 1990), internalise (Nonaka, 1994) and develop knowledge acquired outside the firm.

Nor has the structure of each company been considered, a determining aspect for the implementation of new innovation processes. These concepts can undoubtedly be the subject of future research.

Conclusions

Small enterprises in the city of Sucre are mainly in the service sector, with between 10 and 15 employees and for the most part have been in business for between 10 and 17 years.

Relational capital is made up of the relationship that exists between the company, its suppliers, its main competitors and the institutional sector in which it is inserted.

There are companies that consider themselves innovative, because they consider that they have achieved innovation achievements: their innovation processes surpass those of their closest competitor, they have an institutional image thanks to this aspect and this has contributed to the fact that they have an important portfolio of clients.

Small enterprises in the city of Sucre consider it important and essential to develop innovation processes, but many associate it only with the introduction of new technologies.

Companies innovate, but most of them do so internally, without collaboration or relationship with their environment, especially with their competitors.

There is a positive relationship between the establishment of relational capital and the innovation processes of small enterprises in the city of Sucre, but only 37% of this innovation results from the formation of alliances along and outside the value chain. Future research can analyse how to strengthen these alliances to achieve an increase in this relationship.

19.3 Acknowledgements

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The levels of micro business production based on the phases of gypsum production through the descriptive method in District 2 of the Municipality of Sucre 2012

Medición de la eficiencia de marketing en el sector turístico del municipio de Sucre

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Abstract

This research ore tends to determine the production levels of district level 2 at Sucre municipality in the exit to Cochabamba area and nearby places, determining how many small enterprises exist, how big is their production and which machinery is used and which labor force exists. The plaster production includes dehydration or calcination, smashing or "chancado", packing, presentation, study tests, storing, etc. These phases are not performed completely by the small enterprises, and this research describes the study tests performed empirically and without a specific laboratory. The other phases have their own weaknesses during their process highlighted in de data analysis. It is proposed to improve the plaster production process, organization and distribution staring at a re-engineering and industrial technification in its production, by analyzing how many local enterprises work in this activity.

Production levels, Plaster production process

Resumen

Este mineral de investigación tiende a determinar los niveles de producción del nivel distrital 2 del municipio de Sucre en la salida a la zona de Cochabamba y lugares aledaños, determinando cuántas pequeñas empresas existen, qué tamaño tiene su producción y qué maquinaria se utiliza y qué mano de obra existe. La producción de yeso incluye la deshidratación o calcinación, el aplastamiento o "chancado", el embalaje, la presentación, las pruebas de estudio, el almacenamiento, etc. Estas fases no son realizadas en su totalidad por las pequeñas empresas, y esta investigación describe las pruebas de estudio realizadas de forma empírica y sin un laboratorio específico. Las otras fases tienen sus propias debilidades durante su proceso, que se ponen de manifiesto en el análisis de los datos. Se propone mejorar el proceso de producción de yeso, la organización y la distribución mirando a una reingeniería y tecnificación industrial en su producción, mediante el análisis de cómo muchas empresas locales trabajan en esta actividad.

Niveles de producción, proceso de producción de yeso

Citation: CHEZZI-DELGADO, Fabián, GUEVARA, Natalia, BORJA-RONAL, Subelza and WILBER-FRANZ, Choque Balcera. The levels of micro business production based on the phases of gypsum production through the descriptive method in District 2 of the Municipality of Sucre 2012. Journal- Macroeconomics and monetary economy. 2021. 5-8:15-22.

† Researcher contributing first author.

Introduction

In recent years, the production of gypsum has increased in the municipality of Sucre due to various factors such as the growing demand in construction, and the initiative of manufacturing enterprises in the production of gypsum.

Therefore, the present investigation seeks to corroborate in determining the levels of production that exist in district 2 of the Municipality of Sucre, made up of the exit area to Cochabamba and adjacent places, determining how many micro-enterprises exist, how much production is, what machinery they use. And what workforce do they have?

Currently, the exit area to Cochabamba has the main supplying micro-enterprises of the Municipality of Sucre, so it is pertinent to see the industrial technification to which it is projected by having 37 gypsum quarries that exist in the province of Poroma, a direct neighbor. of the Oropeza province.

This factor is conducive to the exploitation of limestone in its different varieties and types, which are mostly brought from Poroma; Milluni, Piosera, Pojpo, main places of extraction of the raw material.

The production of gypsum involves the processes of dehydration or calcination, crushing or crushing, grinding, bagging, presentation, study tests, storage, etc. These phases are not completely carried out by the micro companies, which is why the present investigation describes that the study tests that are carried out are empirical and there is no specific laboratory for this study. As well as the other stages, they have weaknesses in the extended process in data analysis.

Background

Currently there are articles in Correo del Sur, referring to the gypsum quarries that the department of Chuquisaca has in the Province of Poroma, and some reports on proposals to improve gypsum production in certain companies in the Municipality of Sucre, without contemplate the evolution of the production of the manufacture and commercialization of the plaster at general, specific levels.

And with respect to this year, no proposals or investigations have been made on the subject, as well as there are no statistical data regarding the production of reliable plaster.

At the Bolivian level, it can be said that it has 92 deposits of gypsum or hydrated calcium ($CaSO_4$ $2H_2O$) located mainly in the altiplano region and the sub-Andean belt, mainly exploited in the department of La Paz.

It was evidenced that there is an investigation of the Carolina plant in the library of the business administration career regarding the Carolina plaster company regarding the increase in plaster sales, and other directed works that collaborate with the investigation to carry out this management.

Methodology

Materials and methods

The diagnostic study, to carry out this research, was carried out in five different stages:

First to stage: started from the documentary, theoretical, methodological review of the production of plaster in district 2 of the Municipality of Sucre.

Second stage: it started from the determination of the population and sample; and the elaboration of diagnostic instruments, interviews whose instrument will be the interview guide, the application of the observation guide, and the application of the survey, these instruments will allow qualifying and quantifying the information that is intended to be collected.

Third stage: It started from the application of the instruments to the population of workers, owners and administrators of micro-enterprises related to the production of plaster in the Municipality of Sucre.

This is how the application of empirical methods is executed, such as: the survey, the observation, the interview with its instruments:

- Interview guide.
- To survey guide.

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Fourth stage: Throughout the entire investigative process and in its different stages, the following theoretical methods were used to structure the research, such as:

- Historical-logical method.
- Inductive-deductive method.
- Systemic method.
- Method analysis and synthesis.

That will allow to study the problem to analyze all the information regarding the production of gypsum in district 2 of the Municipality of Sucre in this way will allow to build the structure of the final report.

With the use of statistical methods, inductive-deductive, we proceeded to the analysis and interpretation of all the information obtained from the application of instruments and the elaboration of statistical graphs.

Fifth stage: We proceeded to the organization and elaboration of the final report of the investigation that will contemplate all the data obtained in the diagnosis to determine the levels of micro-enterprise production from the phases of gypsum production through the quantitative descriptive method in District 2 of the Municipality of Sucre 2012. Once the presentation of the report has been analyzed, it is prepared for the presentation and socialization of the research carried out.

Poblation and sample:

Población	Muestra
5 microempresas	5 microempresas
5 propietarios	5 propietarios
65 trabajadores	50 trabajadores

Table 1

Results and discussion

Results obtained

Analysis of the interview aimed at managers and owners of micro-enterprises producing gypsum

The present work starts from the following objective that it seeks: To identify the main characteristics of the gypsum production of district 5 of the city of Sucre from the exploitation of limestone.

The interview was conducted with 5 different owners of plaster factories and they responded as follows:

1. Since when have you been engaged in this activity?

Empresa	Tiempo
Yesería Gomes	12
Yesería San Martín	5
Yesería Juan Pablo	8
Yesería Carolina	9
Yesería Jerusalén	10

Table 2

They said that they dedicate themselves to this activity between 5 and 12 years of work experience.

2. How many people work in this business?

Empresa	Trabajadores
Yesería Gomes	16
Yesería San Martín	8
Yesería Juan Pablo	10
Yesería Carolina	13
Yesería Jerusalén	15

Table 3

Within each company the workers are varied according to the company that has its own extension and objectives of each employer.

The workers vary between 8-16 people. If the company is small, then the workers are smaller, as in the case of the “San Martín” plasterwork, if the company is large, then the workers are also more numerous because it requires more investment and movement of the company when producing.

In addition, the workers are in different positions, each of which the workers are in the extraction, in the company's plant and others in the distribution and marketing of plaster.

3. What is the raw material used?

The raw material used in the five gypsum producers is "limestone" or called "gypsum stone" which is the raw material for the production of gypsum which is brought from the town of Poroma and the centers of: Milluni, Piosera, Pojpo.

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4. What are the main stages or phases of gypsum production?

The majority responded that they are: extraction, calcination, the crusher or crusher, grinding, bagging, storage and marketing. The test of studies is carried out empirically.

5. How much production do you get monthly?

Empresa	Producción de yeso
Yesería Gomes	3 mil bolsas
Yesería San Martín	2mil bolsas
Yesería Juan Pablo	2 mil bolsas aprox.
Yesería Carolina	3 mil
Yesería Jerusalén	3 mil bolsas aprox.

Table 4

The amount of production varies from each company because some companies produce more and others less depending on the capacity of each producing company.

6. How long does the gypsum production process take from the extraction of limestone?

Empresa	Tiempo
Yesería Gomes	2 a 3 días
Yesería San Martín	2 días
Yesería Juan Pablo	2 días
Yesería Carolina	2 a3 días
Yesería Jerusalén	2 a 3 días

Table 5

The gypsum production process takes place over 2 to 3 days, during which time the crushing, grinding, and grinding are prepared and then bagged.

7. What processing machinery do you have installed?

Empresa	Maquinaria
Yesería Gomes	Maquinaria pesada, maquinaria a diesel como (, chancadora, moledora, trituradora), horno quemador, palas, otros.
Yesería San Martín	A electricidad (Moledora, chancadora, trituradora), transporte para hacer movimiento del producto, hornos quemadores a gas natural. etc.
Yesería Juan Pablo	A diesel(Trituradora, moledora, chancadora, horno quemadora)
Yesería Carolina	A electricidad están instaladas sus maquinarias (molino, trituradora, chancadora) y el horno quemadora es a gas natural.
Yesería Jerusalén	Maquinaria pesada a diesel (moledora, chancadora, trituradora.) horno quemador a gas natural.

Table 6

Thes machinery does not vary from company to company because they all have the same machinery installed, it only varies that some companies have electricity installed and others have diesel.

8. What are the difficulties you are going through to produce plaster?

Empresa	Dificultades
Yesería Gomes	Camino carretero que no se encuentra en buen estado para el traslado de la materia prima.
Yesería San Martín	La infraestructura no es adecuada, amplia el transporte y la carretera.
Yesería Juan Pablo	Transporte, camino carretero,etc.
Yesería Carolina	Camino carretero para traer la piedra caliza hasta la planta.
Yesería Jerusalén	El camino carretero para el traslado de la piedra caliza hasta la planta.

Table 7

Most of the companies go through the same difficulty that is the highway to be able to bring the raw material to the plant because the highway is not in good condition, especially in the rainy season, which makes it difficult to transport this raw material for production. plaster production.

9. How is the crushing and grinding process carried out in the production of plaster?

The crushing and grinding process in the plant of each company through the machinery that they have installed for each phase of the production within the plant of each plaster production company.

Empresa	Proceso
Yesería Gomes	El proceso se realiza atraves de las maquinarias
Yesería San Martín	Se realiza en la planta en las maquinarias
Yesería Juan Pablo	Por fases que son la quemada, la chancacion, trituración, la molienda,
Yesería Carolina	La calcinación ó quemada, la chancacion, la molienda
Yesería Jerusalén	Se realiza en la planta en las maquinarias que existe instaladas.

Table 8

10. How is product quality determined?

Empresa	Calidad de producto
Yesería Gomes	Empíricamente
Yesería San Martín	Empíricamente
Yesería Juan Pablo	Empíricamente
Yesería Carolina	Empíricamente
Yesería Jerusalén	Empíricamente

Table 9

Tests are carried out, prepared from the first grinding of the plaster mixed with water and plastering to the wall all and others observed the color of the grinding.

11. What advantages or disadvantages do you find in gypsum production in the Municipality of Sucre?

Empresa	Trabajadores
Yesería Gomes	No. Solo hay desventajas como los impuestos y la competencia
Yesería San Martín	No hay ventajas
Yesería Juan Pablo	No se dice eso.
Yesería Carolina	No hay ventajas ,más bien hay desventajas para la empresa
Yesería Jerusalén	No sé.

Table 10

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The entrepreneurs of the municipality of Sucre of the production of plaster explain that there are no advantages for their companies, rather instead of advantages they have disadvantages such as government taxes and competition in an illegal way, and the bad ideas of comments against the companies.

12. How is the distribution of the product to the agencies carried out?

Empresa	Trabajadores
Yesería gomes	Mediante los transportes de distribución de la empresa.
Yesería san martín	2 personas encargadas con un solo camión.
Yesería juan pablo	La empresa tiene la distribución mediante los trabajadores encargados para eso.
Yesería carolina	La empresa distribuye de 2 maneras: en la planta y en las agencias.
Yesería jerusalén	

Table 11

The distribution of the plaster product is carried out by distributor transport with the people in charge who collect it from the plant and transfer it to the agencies of the same company. For later distribution to customers who prefer this product.

13. Is there government support for this sector?

Empresa	Trabajadores
Yesería gomes	No existe nada
Yesería san martín	No existe
Yesería juan pablo	No existe
Yesería carolina	No existe nada porque es una empresa privada.
Yesería jerusalén	No conocemos nada

Table 12

For gypsum producing companies there is no government or other support because these companies are private and do not depend on anyone.

14. Do they have any training constantly or occasionally?

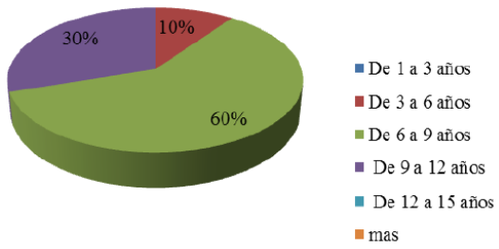
Empresa	Trabajadores
Yesería gomes	No, los trabajadores ya tienen experiencia.
Yesería san martín	Los trabajadores ya saben trabajar empíricamente
Yesería juan pablo	Cada trabajador ya están preparados para sus funciones
Yesería carolina	Los trabajadores ya saben y tienen conocimiento del trabajo que realizan
Yesería jerusalén	Ya están preparados.

Table 13

Training for these companies is no longer adequate because a work experience gained enough knowledge the workers already have empirically so that they can work in the different companies.

Analysis of the surveys applied to workers in the production of plaster

1. Working time



Graphic 1

In this graph it can be seen that 60% of the workers have an experience of between 6 to 9 years of work, 30% of the workers have between 9 to 12 years and 10% between 3rd 6 years of experience.

2. Gypsum production per month

Graphic 2

In this graphic it can be seen that 26.92% of the production is carried out by Yesería Jerusalem, and 23.08% of plaster production is carried out by Yesería Gomes, 19.23% is made by Yesería Carolina, fourth and fifth place is shared by Yeserías San Martin and Juan Pablo with 25.38%.

3. Difficulties faced by companies in the production of plaster

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Graphic 3

It was possible to identify that the main difficulty that workers go through is the dust that affects their health with 40%, also with 20% it was possible to see that another difficulty is occupational safety, it can be seen that 20% they are the environments and similarly with 20% it is also the highway for the extraction of the raw material.

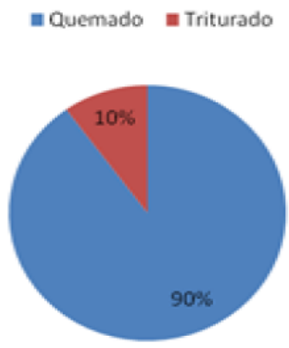
4. Main machinery for plaster production

In the present investigation it was identified that the main machinery that the plasterworks have are:

- Heavy machinery.
- Burner furnace.
- Crusher/Crusher.
- Grinder.
- Transport.

They are the ones mentioned and identified by both owners and respondents.

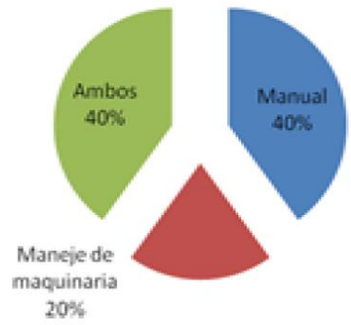
5. Most complex stage of plaster production



Graphic 4

In this graphic it can be seen that the most complex stage of production is burning with 90% of the responses and 10% mentioned is grinding or crushing.

6. Type of work carried out in the production of plaster



Graphic 5

In this graphic it can be seen that 40% of the workers mention that the type of work they do is both manual and machine operation. Similarly, the other 40% perform empirical or manual work, 20% do it in the management of industrial machinery.

Discussion

After the application of the empirical instruments, it was found that the gypsum production process is artisanal and semi-industrial, also that the most complex stage in production is calcination because there is no oven for drying and dehydration by temperature. and time, but it is manual, as well as bagging and distribution, another aspect of analysis is that a laboratory study is not carried out to know the quality of the product, but the study is empirical, it is highlighted that the workers mostly have experience, but they do not have job security and this is related to the low prices of plaster in the local market.

Since, unlike international prices, it is very cheap. In the present investigation, we start from the hypothesis "the levels of micro-enterprise production do not reach all the phases of gypsum production in District 2 of the Municipality of Sucre", in which it can be identified that the level of production of district 2 in Regarding the elaboration, production of the plaster is semi-industrial and artisanal and currently the entire process is not fulfilled, there are greater weaknesses in; laboratory tests, bagging and calcination or dehydration.

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An outstanding aspect of the research is the improvement in terms of machinery, the main machinery that the plasterworks have are:

- Heavy machinery.
- Burner furnace.
- Crusher/Crusher.
- Grinder.
- Transport.

They are the ones mentioned and identified by both owners and respondents. What is of concern in the present investigation is the little support that exists on the part of the municipal and departmental government, in terms of technical, logistical support that promotes the economic policies of industrial development for this area, despite the interviewees stating that they contribute from more than ten years paying taxes for the extraction of limestone, gypsum or (calcium sulfate dihydrate: $CaSO_4 \cdot 2H_2O$).

Currently, there is no evidence of the existence of articles referring to production or statistical data that are oriented to the specific production of gypsum and some producers do not want to provide data regarding the subject, so they think that their labor source can be taken away from them.

Conclusions

After conducting this research, the following conclusions can be reached:

These characteristics of gypsum production include transportation, grinding, calcination or burning, followed by crushing or crushing, then grinding.

It was possible to identify that the production of plaster in district 5 of the city of Sucre is not very technical and still empirical.

We conclude that the main machinery they use is the oven, the crusher, the grinder, mainly heavy equipment has not yet been installed and no laboratory tests are carried out, the tests to see the quality level of the plaster is empirical.

The main supplier of limestone "gypsum stone" is Milluni and the Poroma sector supplies all the plasterwork of district 2 of the city of Sucre.

For the production of plaster there are approximately between 8 and 16 workers.

All the plasterworks produce and distribute this product and have several branches in different sectors of the Municipality of Sucre.

The exploitation time that the different companies have is from 5 to 12 years and depending on the time they have a vast expansion and distribution of this product.

The age of the asylum workers is between 6 and 9 years old in the majority.

The type of work carried out in the production of plaster is largely mixed and manual by the workers.

Recommendations

The following suggestions are made:

It is necessary to carry out research regarding the production of gypsum at the Sucre level, contemplating the different districts of Sucre.

Another relevant investigation would be to determine the amount of aljez or limestone that exists in Milluni and Poroma due to its supply that it may have at the local and national level to develop large-scale projects.

With respect to the gypsum producers, it is necessary that they form an association or mutual society to expand, technify with heavy machinery and make more investment before someone presents projects that in the future compete with medium production.

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Comparative analysis of performance, cost and energy production between the isolated and interconnected system of the corrugated cardboard company Puebla S.A. de C.V.

Análisis comparativo de rendimiento, costo y producción energética entre el sistema aislado e interconectado de la empresa cartón corrugado Puebla S.A. de C.V.

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Abstract

Mexico aims to reduce emissions of greenhouse gases by 30% in the period 2020-2030, in order to achieve it have developed alternative technologies such as solar photovoltaic. In this type of technology come Corrugated Puebla SA The photovoltaic systems, so that in this work an autonomous photovoltaic sizing analysis was performed and interconnected network for company offices de CV in order to reduce the cost billing by Federal Electricity Commission. an energy analysis was performed and both photovoltaic systems were sized for the number of panels, inverters, wire gauges and structures were designed to install the system, the energy consumed by the company is 13.23 kWh / day. In the interconnected grid system investment it is 42.69% lower compared to the autonomous. The return on investment for the grid is 9 years and for self is 14 years.

Photovoltaic effect, Autonomous system network interconnected system, Panels, Regulators, Investors

Resumen

México tiene como objetivo reducir las emisiones de gases de efecto invernadero en un 30% en el periodo 2020-2030, para lograrlo se han desarrollado tecnologías alternativas como la solar fotovoltaica. En este tipo de tecnología entran los sistemas fotovoltaicos de Corrugados Puebla S.A., por lo que en este trabajo se realizó un análisis de dimensionamiento fotovoltaico autónomo y de red interconectada para las oficinas de la empresa de CV con el fin de reducir el costo de facturación por parte de la Comisión Federal de Electricidad. se realizó un análisis energético y se dimensionaron ambos sistemas fotovoltaicos por el número de paneles, inversores, calibres de cables y se diseñaron las estructuras para instalar el sistema, la energía consumida por la empresa es de 13.23 kWh/día. En el sistema de red interconectada la inversión es un 42,69% menor en comparación con la autónoma. El retorno de la inversión para la red es de 9 años y para la autónoma es de 14 años.

Efecto fotovoltaico, Sistema autónomo Sistema interconectado de red, Paneles, Reguladores, Inversores

Citation: FLORES, Oscar, GONZALES, Ricardo, JUAREZ, Victoria and HUITZIL, Ignacio. Comparative analysis of performance, cost and energy production between the isolated and interconnected system of the corrugated cardboard company Puebla S.A. de C.V. Journal-Macroeconomics and monetary economy. 2021. 5-8:23-30.

† Researcher contributing first author.

Introduction

The main problem that exists worldwide is the excessive use of fossil fuels for the generation of electrical energy, which is necessary for all the activities of humanity, this causes irreversible climatic damage to the planet, a way to reduce this problem is the use of renewable energy such as solar energy, through the design, installation and commissioning of photovoltaic systems.

Mexico has a variety of resources to take advantage of, one of them is solar energy, since due to its geographical location the variety of climates and ecosystems allows the use of this resource, in particular the state of Puebla receives considerably good solar radiation. The conversion of solar energy to electrical energy is carried out by means of photovoltaic cells thanks to the photoelectric effect, this effect is based on the ability of some materials, in this case Silicon, to emit electrons when they are irradiated with certain frequencies of light. ultraviolet or visible.

In the present work, electrical and electronic materials were used to implement two photovoltaic systems; one island type and another with connection to the federal electricity commission network to supply the electrical needs of the company Cartón Corrugado Puebla SA de CV, located at Calle República del Perú 6A, residential Santa Cruz 72150 Puebla, Pue. Mexico.

It was found that the electrical needs of the company Cartón Corrugado Puebla SA de CV can be mitigated through these photovoltaic systems and it was noted that the system interconnected to the Comision Fedreal de Electricidad (CFE) network is cheaper than the autonomous system by 42.69 % , the only disadvantage of this system is that when there are power supply failures to the company by CFE, the photovoltaic system will not be able to remedy this lack of electricity because the investors cut off the supply for protection, instead with the photovoltaic system Autonomous if there will be electricity, since there will be a battery bank where the energy produced by the system that supplies the company is stored.

Background

Photovoltaic solar energy has been an elementary resource for the development of life on the planet, today it is an outstanding resource in the production of electrical energy, reaching a remarkable relevance throughout the world. In Mexico, the Federal Electricity Commission (CFE) has been producing electricity from solar energy in Sonora since 2008. A park was built to create electricity in Puerto Libertad, where 25 MW are produced.

In March 2007, the Mexican federal government authorized the injection into the electricity grid of small-scale solar energy production, that is, the surplus energy from small photovoltaic installations.

With this measure, it is intended that CFE take advantage of the energy surpluses of the electricity generating facilities through renewable procedures. With this regulation, photovoltaic installations will be allowed to sell their surplus production to the grid during times of sunshine and take it from it at times when it is not available. The foregoing, depending on the rates that are applied in the purchase-sale relationship of that energy by the CFE.

According to the National Association of Solar Energy (ANES), until 2006, practically all photovoltaic systems installed in Mexico were in applications isolated from the electrical network (rural electrification projects, communications, signs, water pumping) and yet, as of 2007, there are records of applications connected to the electricity grid. This trend has been maintained in subsequent years in such a way that in 2010, of the 35 MWp installed in that year, around 94% were systems connected to the electricity grid. In 2014, the Aura Solar I plant was installed in La Paz, Baja California Sur, a plant with a capacity of 39 MWp.

Other representative installations of photovoltaic systems connected to the grid (FVCR) are: Pilot system in Hermosillo, Demonstration system in Monterrey, Energy Research Center of the National Autonomous University of Mexico (CIE) in Temixco, Morelos, Popular Autonomous University of Puebla with a 75 kWp installation and the Amozoc Polytechnic University with a 50 kWp installation.

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Within the applications of autonomous photovoltaic systems, space applications, telecommunications, electrification of rural and isolated areas, public lighting, water pumping stand out. The applications of interconnected systems are photovoltaic plants and photovoltaic buildings, as well as companies. These systems are integrated into roofs, walls and facades.

Objetives

General objective

Dimension and carry out an economic and energy comparison analysis between an autonomous photovoltaic system and an interconnected network for the offices of the company Cartón Corrugado Puebla S.A. de C.V.

Specific objectives

- Carry out an energy diagnosis of all the equipment and lamps in the offices of the company Cartón Corrugado Puebla SA de CV

- Calculate the number of system elements (panels, regulators, batteries and inverters).

- Compare autonomous photovoltaic sizing with grid interconnected based on costs and benefits.

Hypothesis

If the proper sizing and analysis of the cost and energy production of the autonomous photovoltaic systems and interconnected to CFE is carried out, a decrease in energy consumption can be observed, this will achieve economic savings, and it can be confirmed that the interconnected system is more suitable for the company Cartón Corrugado Puebla S.A. de C.V.

Justification

As is well known, photovoltaic energy is a clean and viable energy option to be implemented in the supply of electrical energy both in the home and in industry. Therefore, it is intended to make an autonomous and interconnected photovoltaic dimensioning in the offices of the company Cartón Corrugado Puebla S.A. de C.V., and thus reduce the cost of billing or become independent.

Likewise, the use of renewable energies would be promoted since the use of fossil fuels is generating major climate changes on the planet, such as the greenhouse effect, acid precipitation and the thinning of the ozone layer. With the economic and energy analysis, the decision can be made as to which system is more viable.

Materials and methodology

Materials

The materials used are:

- Samlez SAM-2000 inverter (Input characteristics: System battery voltage 12 VDC, input voltage range 10.5 to 15.0 (+/- 0.5) VDC, input current in continuous power 90.5 to 93.5 A. Output: output Voltage Modified Sine Waveform, Output Voltage 115VAC, Output Frequency 60Hz +/- 5%, DC Output 2000W, Highest Efficiency Point 90%).

- Solar Phono Module 150 W Polycrystalline. (Characteristics: Typical application 12 VDC, size 1482(L) x 676 (W) x 35 (H) mm, rated power 150 W, rated current 8.24 A, rated voltage 18.2 V, short circuit current 8.65 A, short circuit voltage open 22.8V).

- Battery Surrete Solar-480 (Capacity 135 Ah, voltage 12 V).

- SIGOR 12V, 40 A charge regulator. (Nominal voltage 12/24 V, maximum input voltage 50/60 V, maximum input current 30, 40 A, maximum output current 30.40 A).

- Fronius inverter 3.0-1. (Nominal power 3680 W, voltage range 90-450 V, nominal current 16 A, maximum number of inputs in parallel 2).

- Solar Phono Module 250 W Polycrystalline (Nominal power 250 W, nominal current 8.3 A, nominal voltage 30.2 V, short circuit current 8.70 A, open circuit voltage 37.8 V).

- Bidirectional meter.

- Structures for panels (Vento4basic).

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- Fuses.
- Rifle holder.
- Connectors.
- Photovoltaic cable.
- Multimeter.

Methodology

Method description

To carry out this project, the following steps were followed:

- Firstly, a study of the area where the photovoltaic system was implemented was carried out, obtaining data such as incident radiation, latitude, climatic variations, etc.
- The energy demand was determinedof the company Cartón Corrugado Puebla SA de CV carrying out an energy diagnosis which consists of accounting for the equipment used, obtaining its electrical characteristics, the time of daily use in hours and subsequently the appropriate calculation is made to obtain the total power required for the proper functioning of the company's equipment.
- Subsequently, the number of panels necessary to supply either partially or totally the energy demand was calculated, also the number of panels that must be connected in series and in parallel, the type of structure to be used to mount the solar panels was determined and finally, the optimum inclination that these should have with respect to the latitude of the place.
- The inverter was dimensioned, that is, we must select the appropriate inverter for our demand. For this, we make use of the aforementioned expression, which expresses that the power that our inverter must have must be approximately equal to the power that we must supply in AC, that is, the consumption that we must satisfy.
- Subsequently, the ideal wiring for our installation was calculated, in which great attention must be paid, since when energy passes through our cables, there will always be losses that are due to the voltage drops that are in them, in addition, these must meet with the Low Voltage Electrotechnical Standards.

Results and Discussion

Results

Table 1 shows the data forincident radiation, latitude, climatic variations, etc.; of the area in which the company is locatedPuebla Corrugated Cardboard.

Characteristic data of the area	
Coordinates	Latitude19°04′24″N Longitude 98°16′00″ W
Weather	Temperate Subhumid
Altitude	2,142 meters above sea level
average maximum temperature	28.5°
Average days with rain	110 days
Average number of cloudy days per year	80 days
Average number of sunny days per year	175 days
Peak solar hour hsol	5.5 h/day

Table 1 Characteristic data of the area

Table 2 shows the calculations of the energy consumed by the electrical and electronic devices of the company Cartón Corrugado Puebla.

Appliances	No. of devices	Power (W)	h/day	Wh/day
office spotlights	fifteen	25	9.5	3,562.5
hallway spotlights	5	25	2.0	250
bathroom spotlights	5	25	1.0	125
Computers	6	110	9.5	6,270
Fan	one	600	4.0	2,400
Laptop	one	81.70	7.0	571.9
Printer	one	18	3.0	54
Total				13,233.4Wh/day

Table 2 Total power consumed in the company Carton Corrugado Puebla S.A. de C.V.

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In order to carry out the adequate photovoltaic dimensioning for the company, the daily load was calculated using the total power and the power of the system that was implemented, as can be seen in equation 1:

$$C_{diaria} = \frac{P_{TOTAL\ Wh-día}}{V_{sistema}} = \frac{\frac{13{,}233.4Wh}{dia}}{12V} = \frac{1{,}102.78Ah}{dia}$$

In order to compensate for the losses in the batteries and other components we use equation 2:

$$l_s = C_{diaria} \times f_{seguridad} = 1{,}102.78Ah/dia \times 0.2 = 220.55Ah/dia$$

To calculate the corrected current daily load in amp hours per day, we apply Equation 3:

$$C_{dcc} = C_{diaria} \times f_{seguridad\ total} = \frac{1{,}102.78Ah}{dia} \times 1.2 = \frac{1{,}323.33Ah}{dia}, \quad (3)$$

$donde\ f_{seguridad\ total} = 120\%$

The current AS that the system will have to produce is obtained with the following equation 4.

$$A_S = .\frac{C_{dcc}}{h_{sol}} = \frac{1{,}323.33Ah/dia}{5.5\ h/día} = 240.60A (4)$$

To obtain the number of modules we use the current ASm produced by the proposed module for the system, and the amperage that the system will have to produce, as shown in equation 5:

$$N_m = . (5)\frac{A_S}{A_{Sm}} = \frac{240.60A}{8.24A} = 29.19$$

Rounding up we have 30 modules.

To obtain the current produced by the modules, equation 6 is used:

$$C_{pm}, (A) = N_m \times A_{Sm} = 30x8.24\ A = 247.2\ A\text{T}$$

The number of regulators Nr is calculated with the current Cpm produced by the proposed module and the current Cr supported by the regulator, as shown in equation 7:

$$N_r = \frac{C_{pm}}{C_r} = \frac{247.2A}{40A} = 6.18$$

Rounding up we have 7 sliders.

The nominal capacity of the Cnb batteries is calculated knowing the days of autonomy, which in this case was chosen as 5 and the depth of discharge Dp = 80%, as shown below 8:

$$C_{nb} = \frac{C_{dcc} \times d_a}{D_p} = \frac{(1{,}323.33Ah/dia)(5dias)}{0.8} = 8270.81Ah$$

To obtain the number of batteries, the nominal charge of the Cnb batteries and the nominal charge of a Cn battery are used, for this system it is 135Ah, as shown in equation 9.

$$N_b = \frac{C_{nb}}{C_n} = \frac{8270.81Ah}{135Ah} = 61.26$$

Rounded up we have batteries 62 batteries.

Knowing the output power Ps of the inverter, which is 2000 W, and knowing the performance factor η = 90%, we can obtain the input power Pe, using equation 10.

$$p_e = \frac{p_s}{\eta} = \frac{2000w}{0.90} = 2{,}222.22w$$

Then the total power is divided by the input power to obtain the number of inverters:

$$\frac{13{,}233.4w}{2{,}222.22\ \text{w}} = 5.95$$

Rounding up, there are 6 inverters for the autonomous system.

To calculate the gauge of the cable to be used in the different sections of the system, the following equation was used:

$$S = \frac{2LI}{\sigma(v_a - v_b)}$$

Where:

S = section in mm^2

L= Length in meters to the receiver

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I= current in amps

$(v_a - v_b)$=voltage drop in volts

σ=conductivity (inverse of resistivity, copper=56)

The total copper cable used for the stand-alone system was 84 m of 6 AWG gauge and 100.32 m of 8 AWG gauge.

Figure 1 shows the arrangement of the autonomous photovoltaic system made based on the calculations obtained previously, where the modules, regulators, batteries, inverters and consumption in direct current and alternating current are observed.

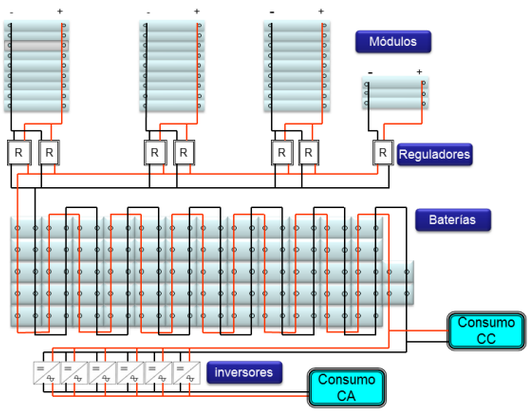

Figure 1 Autonomous photovoltaic system

Calculations made for a photovoltaic system interconnected to the grid

With the energy diagnosis, the total power of the system was obtained, which was 13,233.4 Wh/day, and with the value of the power of the inverter so that it works properly we can obtain the number of inverters, this was done using equation 12:

$$n_{inversores} = \frac{p_{total\,wh-dia}}{p_{inversor}} = \frac{13{,}233.4wh/dia}{3{,}450w} = 3.83$$

With this value, it was decided to use 4 inverters.

The arrangement of the photovoltaic panels is determined based on the input specifications of the inverter, and the output specifications of the photovoltaic panel, therefore we have:

$$No.\,de\,modulos\,en\,serie = \frac{V_{inv}}{V_M} = \frac{210V}{30.2V} = 6.34$$

Rounding up we have 7 modules in series.

To obtain the number of modules in parallel we use the inverter input current Iinv and the module current IM, as shown in equation 13:

$$No.\,de\,modulos\,en\,paralelo = \frac{I_{inv}}{I_M} = \frac{15\,A}{8.3A} = 1.8$$

Rounding up we have 2 modules in parallel.

To calculate the number of modules we apply equation 14.

$$n_{modulos} = (No.\,de\,modulos\,en\,paralelo \times No.\,de\,modulos\,en\,serie \times n_{inversores}) == (2\,modulo\,en\,paralelo \times 7 modulos\,en\,serie \times 4\,inversores) = 56\,modulos$$

The minimum distance between panel edges to avoid shadowing another panel was 1.74 m.

Total cable used for a system connected to the network is 100m of 8 AWG gauge and 24m of 4 AWG, this was obtained with equation (11).

Figure 2 shows the photovoltaic system interconnected to the grid, elaborated with the data obtained from the previous calculations where the different components that make up a system interconnected to the grid are observed.

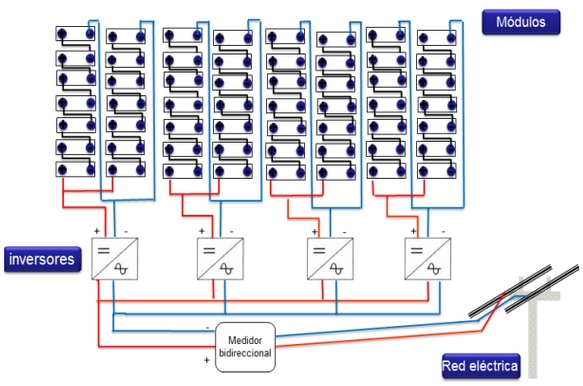

Figure 2 Photovoltaic system interconnected to the network

Tables 3 and 4 show the price of a photovoltaic system interconnected to the network and an autonomous one, where the prices per unit of each element and the total price of each of the systems can be seen.

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Product	No. of products	$ Unit price	$total price
150w polycrystalline solar phono module	30	3200	96,000
Surrete solar battery s-480	62	4000	248,000
Zygor regulator	7	3995	27,965
samlex sam-1000 inverter	6	4500	27,000
6AWG wire	100.32 m	32.5 m	3,607.5
8AWG wire	84 m	28 m	2352
Vento4basic (capacity of 4 panels)	7	850	5,950
Vento2adic (capacity of 2 panels)	1	500	500
Protective elements.	Various	4000	4000
Total price for all system components: $413,374.50			

Table 3 Costs of the elements of an autonomous photovoltaic system

Product	No. of products	$unit price	$total price
Solar phono module 250w polycrystal linen	56	3,500	196,000
xantrex GT5 inverter.	4	6,000	24,000
6AWG wire	24 m	32.5 m	780
8AWG wire	100 m	28 m	2800
Vento4basic (capacity of 4 panels)	14	850	11,900
Protection and installation elements.	various	10,000	10,000
Total price for all system components $235,840.00			

Table 4 Costs of the elements of a network interconnected system

Discussion

According to the results, we can say that the interconnected photovoltaic system is more energy efficient since we will always have electrical energy despite if the days do not have enough radiation, since the current that is needed for the equipment to function will be taken from the grid CFE.

On the other hand, an autonomous system would not have the capacity to fill the batteries 100% and would not be able to power all the company's equipment and when there is enough radiation, it can be wasted since once the batteries are full, the charge regulator cuts off the passage of the current to prevent them from being damaged, instead the interconnected system injects the excess energy into the CFE network so that in the end the company reduces the cost of the energy used.

The interconnected system is also more efficient in terms of space, since the 62 batteries occupy a larger area than the bidirectional meter and care for the batteries must be special since they can be damaged by moisture.

The interconnected photovoltaic system is less expensive than the autonomous system as seen in the prices; in 42.6% this makes the interconnected network more attractive since the return on investment is faster. Autonomous systems could be made more efficient but these would become even more expensive, due to the increase in the number of batteries and the fact that only 80% of the energy stored in them can be extracted

Gratitude

The researchers thank the Polytechnic University of Amozoc and the company Cartón Corrugado Puebla SA de CV for the support provided for the development of this project.

Conclusion

Based on the data obtained, it was concluded that both systems supply the consumption of electrical energy within the company Cartón Corrugado Puebla SA de CV However, in the system interconnected to the network, the investment is 42.69% lower compared to the autonomous system, the advantage The main thing about autonomous is that it is not dependent on the network.

Finally, it can be said that the system interconnected to the CFE network is more viable for the company Cartón Corrugado de Puebla SA de CV, since it is more efficient and less expensive.

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In addition, its return on investment is approximately 9 years, while the autonomous system, its return is 14 years, but this period can be increased since at 5 years or earlier the batteries would have to be changed and therefore the cost of the system. autonomous would increase.

For the interconnected photovoltaic system, maintenance is almost zero and the system has a useful life of approximately 25 years, while the autonomous system requires more maintenance, especially in the batteries, since their life cycle is approximately 5 years. With this system, 8.6 tons of carbon dioxide are not emitted into the atmosphere per year, helping to reduce climate change.

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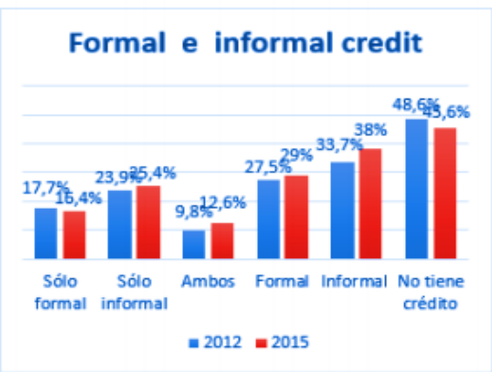

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