

**IMPLEMENTATION OF A NEW SOCIO-ECONOMIC MODEL OF INNOVATION
MANAGEMENT FOR ARTISANAL, MICRO, SMALL AND MEDIUM COMPANIES IN
THE PHARMACEUTICAL FIELD IN COSTA RICA**

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ABSTRACT

In 2014, the structure of a socioeconomic model of innovation strategies applied for artisanal, micro, small and medium companies (ARPYMMES in Spanish), was published in the “V Congreso Universidad” developed in La Havana, Cuba. This model has been successfully applied in Costa Rica, consolidating economic nucleus in rural zones and areas with high poverty, and offering support to sensitive population groups; such as women head of household, persons with disabilities or low academic degree and regions with low formal jobs or industrialization. Since 2010, there has been an increase in the support requests which has, in turn, made the logistical aspects of the model become slower. This is the main reason to redesign the innovation model, looking for involve bigger ARPMMES groups and working in a network with different socioeconomic sectors. The current work is a descriptive observational study. The main objective is to describe the implementation of a new socioeconomic model to act on the ARPMMES innovation and articulation with social sectors interested in the pharmaceutical field, through a relationship between the University of Costa Rica, the Faculty of Pharmacy, and the Institute of Pharmaceutical Research (INIFAR). This work describes the model basic principles, the ARPMMES characterization and classification, the ARPMMES articulation, some real examples and the results obtained with the model implementation. The methodology was an observational analysis, based on the recollection, revision and prospective triangulation analysis of the decisions taken by some participants, such as economical activities, number of sales points, number of products per company, number of commercial, social and innovation relationships; and the interactions between economic nucleus. In this study, it was found that the application of the model increased the number of sales spots, the number of selling products, the number of socioeconomic interrelations and a number of economic resources for innovation and development. Also, new investigation projects were executed and the activities between students, investigators, and socioeconomic sectors also increased.

KEYWORDS: Socioeconomic Development, Innovation, Pharmaceutical Industry, ARPMMES, Relationship Between Enterprise – University – SOCIETY.

INTRODUCTION

In 2014, the results of the implementation of an innovation strategies model applied for artisanal, micro, small and medium companies (ARPYMMES) was presented in the “V Congreso Universidad” developed in La Havana, Cuba. The model implementation was described using a cosmetic company which production is based on goat milk. The company is located in the rural zone of Acosta, San Jose, it is led by women and support low-income sectors and low-industrialization places. The model bases are mention below

1. Relationship between the University-Community-State
 2. Maximum risk reduction
 3. An efficient use of resources located in the region and the country.
 4. Eco-friendly and sustainable development.
 5. Scientific applied development.
 6. Innovative products and services with added value.
 7. Import substitutions.
 8. Social equality and new opportunities to excluded or sensitive socioeconomic sectors.
- The methodology used for the aforementioned steps is described below:
9. Find a small company or person with a product, service or need to be developed. The company has to be led by women, disabled persons, individuals in drug rehabilitation, inmates, rural zones, highly impoverished individuals or other factors of social exclusion.
 10. Integrate an interdisciplinary team in the action field of the company, with technical, regulatory, commercial, publicity, intellectual property, and economic experts.
 11. Involve university students, as active participants, in the activities to develop the project.
 12. Make a project framework with objectives, chronogram, budget, strengths, weaknesses, needs, and perspectives for two years' time limit.
 13. Find financial support by participation in innovation competitions, support projects for small businesses, social development projects, etc.
 14. Deploy the project and commercialize the products and services that have been developed in local markets, substituting imported or foreign products.
 15. Evaluate the project's objectives and the commercialization results with the persons involved in the entrepreneurship projects.
 16. Repeat the procedure to increase the commercialization objectives of the enterprise until its consolidation.^[1]

The model mentioned above differentiates from others in the following aspects.

Technological parks: the main advantages of technological parks are the infrastructure, top technology for development, fiscal advantages, funding access, investors and highly-skilled personnel. This creates a large cost, and the production nucleus has to move to the park and its surroundings to take full advantage of all the available resources and the interaction between different sectors. Also, the critical, scientific, economic, and

technologic mass must be large, which is related to implementation problems in small countries with poor infrastructure and other similar factors.^[2, 3]

Enterprise accelerators: it is the most flexible model created around universities and enterprises. The ideas are taken by many actors, such as intellectual property agencies, innovation focused models, investigation projects, students, teachers or databases. A basic infrastructure, training, administrative support, interaction spaces, and even the option of financing are present in the model. The most relevant model disadvantages are the short periods of development and monitoring, low technical support, no technological infrastructure, and the interaction between economic nucleuses is limited, emphasizing in commercial relations.^[4,5,6]

The Faculty of Pharmacy of the University of Costa Rica was founded on 1897 and the Institute of Pharmaceutical Research on 1994. Both of these entities belong to the University of Costa Rica. They have been dedicated to the research in the pharmaceutical field, like formulation, analysis, quality control and applied investigations. However, there is an inherent need to increase the relationship between these two entities and the national production sectors.^[7]

Starting from the research group experiences in the investigative pharmaceutical field and after receiving many requests by ARPYMES and physical individuals, it was found that the implemented model usually resolve the aforementioned disadvantages without affecting their advantages. However, due to the low number of personnel and administrative resources, the model needs to be modified to achieve an administrative optimization, methodology systemization, and improve the overall operation capabilities, like entrepreneurship, articulation, and innovation.^[1]

The new model pretends to advise and provide a full-cycle support to the enterprise until the product commercialization. This model does not make the old one obsolete, they are actually interlaced and adapted to a higher number of actors. In this paper, we present the results obtained in the enterprise “La Pequeña Granja” as an initial validation of this new model implementation.^[1]

The External Commerce Promotors of the Ministry of External Commerce, Proexport and Prochile have conducted studies about the pharmaceutical field in Costa Rica. Their results inform that medications, natural products, and cosmetics are the emerging markets in this field, being cosmetics the products with a higher growth rate.

Costa Rica has a high involvement in the importation of cosmetic products, which favors imports substitution by local entrepreneurship, which has advantages such as knowing the local market, acknowledgment of the

products, access to abundant natural resources, a fast distribution and the ability to adapt to new trends. Internationally, the European and American markets are inclined to purchase products based on natural resources, the eco-friendly image that possesses Costa Rica and the high number of tourist that visit this country generates a floating market upper than two million people.^[8, 9, 10]

The new implemented model has been denominated as the Technical Articulation Manager (GAT), the GAT is intended for the articulation, management, investigation, and innovation of all the actors involved. It also provide technological support, maintain economic and socioeconomic nuclei safe, interrelate the actors in all the project's proceedings and sectors (economic, academic, commercial, social), know the social context involved around the ARPYMES, use the model as a sustainable

system for socioeconomic development and make it an important tool for students to apply their pharmaceutical and cosmetic knowledge. Further, the model intends to alleviate the exclusion of members of society such as women, disabled persons, addicted persons in rehabilitation programs, jailed, and extreme poverty population.

The basis of the new model, the applied methodology and the results of the impact evaluation are described below.

MATERIALS AND METHODS

The model basis are the same explained in the introduction, however, there is a difference in the applied methodology and the implementation process, the process is explained below.

Table I. Phases of implementation for the GAT model.

| Stage Number | Stage Name | Description |
|--------------|----------------------------|--|
| 1 | Resource Location | It starts with the existing resources. The main resource is people interested who provide ideas for the project; the second resource is the University who allows their campus to be used for the project and the third resource consists of the monetary resources provided by private and public entities. |
| 2 | Acting profiles | A socioeconomic analysis must be performed on all members of the project, such as companies, students, researchers, financial enterprises involved, ministries, and universities. There are two types of actors that must be differentiated, the judicial or individual actors. |
| 3 | Actor classification | According to the acquired analysis the actors must be classified and characterized to establish the interrelations with other actors and their individual advance on the project. |
| 4 | Administrative Development | The above-cited methodology is applied at this stage and is complemented with stage 8. The objectives are optimizing administrative resources, create synergic processes and potentiate actions. |
| 5 | Actor interrelation | In this stage the relationships between sectors are established, mainly between the members of the productive sector, such as exporters, importers, producers, and distributors. Universities supply with technical and technological support to diminish the differences between actors and to facilitate their actions and articulation. |
| 6 | Impact Evaluation | At this stage variables are measured to establish the impact of the project or model in general. Measured variables can be the number of sold products, number of sale spots, number of products, developed services and employs numbers. |

Principal socio-economic profiles description and classification.

There are several ways to obtain a socioeconomic profile. Therefore one of the main advantages of this model is the ability to be adaptable to the surrounding conditions, the innovation management, and investigation process can be realized *in situ* and *in vivo*. Also, some processes are developed in places with a higher technology and more resources, like University. However, it is fundamental to transfer all the information obtained to the place where the economic activities are performed.

To study the actors' socioeconomic profile, the place, ambient, cultural, social and economic conditions must

be known. The actors' personality needs to be described and the advantages and disadvantages of the processes must be studied. A basic psychological profile about the character and personalities of the involved actors is important since it is necessary to analyze the behavioral aspects, like working under pressure, complex situations and their access to resources such as transport, economy, infrastructure, telecommunications and natural resources.

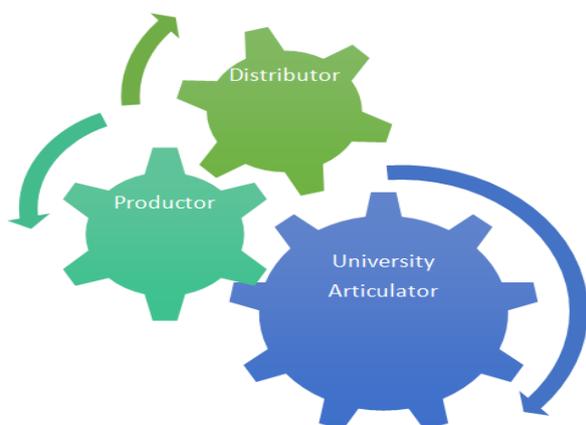
After this profile has been developed for the involved persons, the same must be applied to the organizations that interact with the project, classifying them by their levels of activity. Below is explained an example of the production sector classification.

Table. II: Classification according to production sector profile for the GAT model.

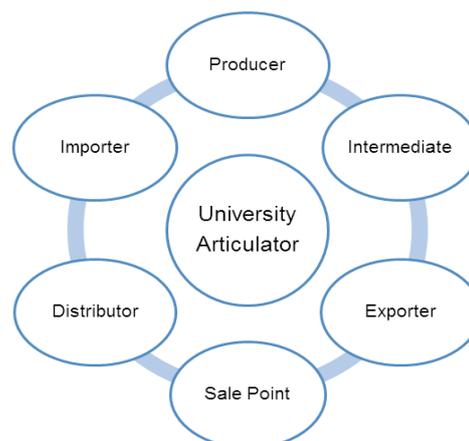
| Level | Actor Description | Types of Economic Activity |
|-------|---|--|
| 1 | All actors who present an innovative or a new idea. The actors could be students, teachers, researchers, ARPYMMES or general people. | They can have a formal economic activity or not. At this stage, some activities are segregated according to their service profiles and their products. |
| 2 | Actors with formal or informal commercial activity that have initiated the idea or project from level 1, without any properly assembled infrastructure. They have not exported yet. | Can be classified as importers, distributors, producers or intermediaries. |
| 3 | Actors with formal commercial activity, with at least 3 years in their respective market. The ideas from level 1 must be developed and sustained. They can have or not infrastructure for their projects and have not exported yet. | Can be classified as importers, distributors, producers or intermediaries. |
| 4 | Actors with formal commercial activities with at least 3 years in the market who have developed and sustained their ideas from level 1. They must have an infrastructure and export their products. | Can be classified as importers, distributors, producers or intermediaries. |

After the classification process, it is necessary to promote and organize meetings between all actors and political, commercial, economic, regulatory and technological authorities. The participation of students, researchers, and professionals is important to the process of building trust between the actors.

The main idea of GAT model is the interaction between actors to solve the need of those actors of the productive sector. The University acts as an implementor and as technological support. For example, a distributor needs a product and a producer needs a distributor for a small-scale product; neither the producer nor the distributor knows how to obtain a sanitary registry, how to develop a product from scratch, the quality control for the product, its stability, packing aspects or any other aspect of the processes prior to selling to general public. In these cases, the University through the Faculty of Pharmacy provides the services that facilitate the interaction of both actors, and also acts as a tool for teaching and developing the skills to realize these activities in the production place. In this way, the University strengthens the relationships between the actors.

**Figure. 1: Description of the articulation process of actors and the productive sector.**

The final objective is to implement articulation chains between the actors. In this way, their complementary services are successfully shared and the support provided by the Faculty of Pharmacy of the University of Costa Rica will be slowly diminishing until reach a group of independent articulate actors, eventually, these groups could incorporate more actors to the productive chain.

**Figure. 2: Example of articulation chain implementation.**

Even though these interrelations seem logic and natural, practiced experience showcases that ARPYMMES have high distrust levels and the lack of communication, counseling, and financing causes a delay in growing process, affecting the productive chain and favoring large enterprises, national and international.

In the final stages, the indicators for evaluating the variables impact are measured. For example, the number of actors or participants per activity, number of actor interactions, number of developed processes, number of sales, number of sales points, number and type of exported products amongst other measurements.

RESULTS

Table. III: Number and type of participants in the GAT model in the 2010-2017 period.

| Level | Number of Participants | Participants |
|-------|------------------------|---|
| | | Productive Sector |
| 1 | 250 | Students of the course “Innovation Management for Health Sciences” during the 2013-2014 period, persons and enterprises that have solicited collaboration from the Faculty of Pharmacy of the University of Costa Rica. |
| 2 | 14 | Naturtico, Coopesarapiquí, Asociación Mujeres de Colinas de Cariari, Le Plesheur Laboratory, ARS Laboratory, Morinté. Laboratorio Dulce Vida ,ASMEVERDE, BIOCAPRI, Evocare, Tiny Bugs.ASOMEJ. Catalinas Collection, Rambuhealth,Inchi |
| 3 | 17 | Healthy Store, Distributor 2, Distributor 3, Carmay SJD, Herrera Laboratories, La Fuente Laboratories, Central Laboratory, Jomi Laboratories, Toque Natural Laboratories, APRACOIIN, Biosfera Laboratories, Bargains Laboratories, Km Rose Laboratories, Labimex, |
| 4 | 5 | Exportadora IGT, La Pequeña Granja Laboratories, Manzaté, Mondaisa. Biosfera |
| | | Academic Sector |
| 1 | 12 | Teachers and researchers of the participant universities. |
| 2 | 6 | Administrative assistants and/or administrative participants or collaborators. |
| 3 | 85 | Assistant students who have been involved in the projects. |
| | | Socioeconomic-Politic Sector |
| 1 | 10 | Ministries, departments and other socio-political actors. |
| 2 | 10 | Financial sector, investors. |
| 3 | 10 | Others from the no-financial sector, International participants, consultants, ONG, etc. |
| Total | 422 | |

Table. IV. Number and type of articulations with the GAT model in the 2013-2014 period.

| Type of Articulation | Quantity |
|--|----------|
| Designed services or products | 1500 |
| Stability studies for the products. | 12 |
| Sanitary registries | 25 |
| Good manufacturing practices consulting | 20 |
| General consulting | 50 |
| Quality control analysis consulting | 10000 |
| Articulation meetings between the involved sectors | 150 |
| Learning and training activities | 100 |
| Intellectual property consulting | 45 |
| Fair organization and participation | 12 |
| Scientific activities divulgation | 50 |
| Enterprise interrelation | 22 |
| Innovative projects designed by students | 50 |
| Research articles | 30 |

As part of the results, the development of the enterprise Dituto S.A. and their brand “La Pequeña Granja” is showcased as an example, which commercializes cosmetic products based on goat milk in Costa Rica, Panama, Canada, and China.

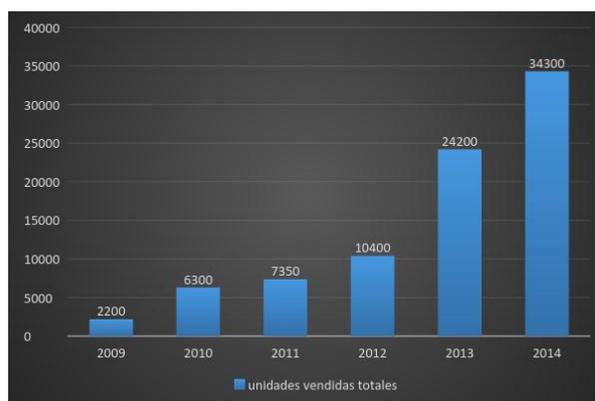


Figure. 3: The number of units sold for the total products commercialized by La Pequeña Granja.

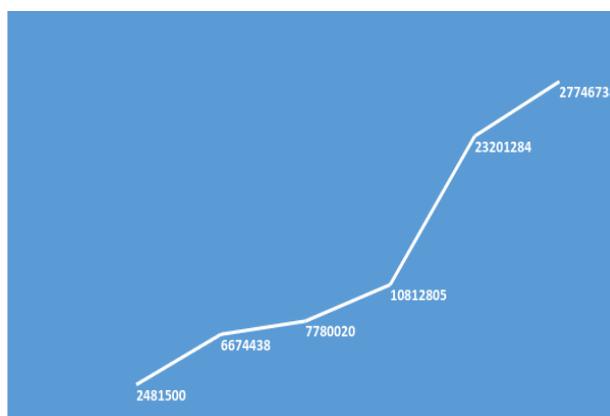


Figure 4. Total sales per year by the enterprise La Pequeña Granja.

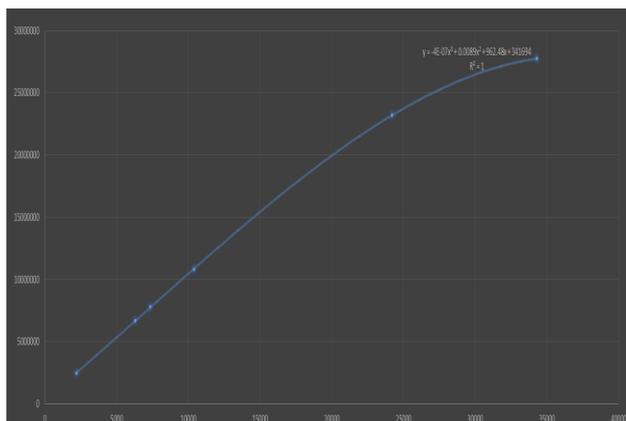


Figure 5. Correlation between total sold units against the total sales by the enterprise La Pequeña Granja.

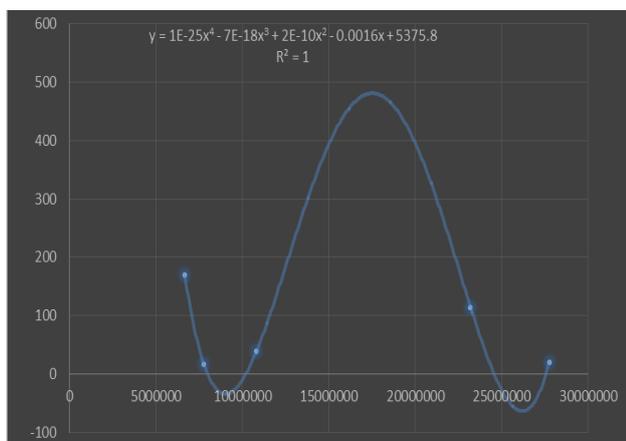


Figure 6. Correlation between the annual increment percentages of sold units against the total sales by the enterprise La Pequeña Granja.

DISCUSSION AND CONCLUSIONS

The Model of Innovation Management in the Faculty of Pharmacy of the University of Costa Rica is characterized by being dynamic, the variables such as articulation activities can be modified according to the needs and context of the participants, and the capabilities learned in the teaching centers are used as bases. The laboratories, equipment usage, professionals, administrative personnel, and infrastructure are used with the finality of optimizing resources.

Another characteristic of this model is its solidarity and cooperation; it does not have a financial objective but takes sustainability as a key focus. Also, this model uses the existent resources from the involved sectors in Table III and strengthens them by articulating their activities (Table IV), with the objective of generating synergic effects for the resources optimization.

The Faculty of Pharmacy can be used as an example of the aforementioned technical articulation. Their installations are used in a planned and systematized form to comply with the model's main objectives, which are: investigation, innovation, sustainability, solidarity, commercialization, cooperation, social action and

teaching. The access to the Faculty of Pharmacy installations promotes the resources optimization, facilitate the work meetings and teaching, also, the laboratories and equipment are used to teaching, innovation, research activities and facilitate the team work between enterprises, students and researchers.

Table III shows that implementation of the described model has inserted 202 participants, individuals, and enterprises, in the innovation development. The actors are divided into three sectors, the productive sector, academic sector and socio-economic-political sector.

The productive sector, in which all the actors are included for their specific productive means, is characterized by activities such as distribution, sales, exportation, production, and importation of goods and services. The students and small entrepreneurs are the basis of the system in this sector since they facilitate de articulation activities that are shown in Table IV. For example, according to the ideas is possible to establish needs and executed articulation actions, like the products or services design.

The academic sector is directly involved in consulting actions such as coordination, administrative and research related actions. The GAT model main objective is to accomplish sustainability of innovation processes without the need to invest in new installations or equipment. The University or research centers are used to develop, optimize and execute the model, which facilitates the insertion and bring support to the productive sector, generating synergy between the actors involved. It is imperative to link research projects with innovation projects to accomplish a full acknowledgment of new concepts with practical needs, which will improve the general population's living conditions in many ways, such as for generating a higher income, increase the dynamic economy and bring solution to everyday problems.

The socio-economic-political sector, include participants like banking entities, ministries, political authorities, financial figures, investors and national and international organisms. The involvement of the aforementioned actors is fundamental in the model due to their facility to execute articulation actions. This sector is related to the finance opportunities, and commercial and regulatory barrier elimination, which promotes the innovation. The economy cannot be unlinked to society; the universities have an important role in the formation of professionals, but also they enhance the research capacities and facilitate the innovation process, which means an impulse in the development of productive capacities of entrepreneurship. The new enterprise needs enough socio-economic-political influence and support to accomplish successfully their creation.

Each new ARPYMME generates new jobs, products, and services, among other dynamic related activities for

general society. A larger number of ARPYME implies a higher market, which means a bigger spread of riches among society and more taxes. Also, formal ARPYMME are related with high social service coverage, more people financing pensions and health-related expenses. These factors enhance the quality of life and imply better services.

Some other advantages linked to ARPYME is the ease of installation, especially in rural or in low resources areas, they have a lower risks factors because of their small nature and their low economic equilibrium point, a faster changing ability and a greater capacity for innovation. However, the capacity of growth, the development activities and investigation and innovation are limited activities. The technical articulation between the involved sectors can alleviate the weaknesses of the ARPYMMES and allows them to overcome such obstacles without much investment.

Table IV showcases the 1445 accomplished activities of technical articulation with 202 organisms or individuals involved with the project. The initial working group was composed of 4 teachers and an administrative assistant. The 4 researchers' time work summary is a full time, and the administrative assistant has a quarter of time assigned to the GAT model. In this way, the implementation of GAT model was possible with synergic actions and without negatively affecting the routinely teach activities.

About the model's sustainability, it is clear that theoretical considerations to describe practical effects tend to be complex. The results show four figures to exemplify the practical results of GAT model applied in the enterprise "La Pequeña Granja", an ARPYMME located in Acosta, Costa Rica. The GAT model needs to be sustainable, so it is necessary that the enterprise commercialize its products guarantying their presence in the market niche and following their context to measure their advance and success.

Figure 3 shows one of the main parameters to measure, it is the number of yearly sold units for the ARPYMME. In this example, the units were over 2200 units in 2009 and reach 34300 during 2014. The technical articulation actions responsible for the increase in unit sales was the design and formulation of new products, such as face creams, hands and feet, a shower gel, a mascara and an intimate soap; all based on goat milk. All the products were analyzed by different studies, such as stability and package studies, selected personnel was taught in Good Manufacturing Practices. It was possible the articulation with distributors from Canada, Panama, and China to accomplish regulations for each of the countries. Financially, the project was developed in the PROPYME program of the Ministry of Science, Technology, and Telecommunications (MICITT) and the National Council of Science and Technology (CONICIT). The

contribution of the enterprise was equivalent to 20% of the project full cost.

Figure 4 shows the enterprise evolution. In the same period, the company rises from 2,438,500 colones to 27,746,738 colones, implying an economic growth of 1137% in the aforementioned period. The correlations in Figure 5 and Figure 6 develop a mathematical model between the total sold units and the total sales, and between the annual growth percentage and the annual total sales. Both models show an exponential grade 3 correlation relate with Figure 5 and a grade 4 correlation related to Figure 6, justifying the articulations and proving they have generated a synergic and exponential company growth.

This company was selected since it is the first chosen to develop the GAT model, which was optimized and bettered in the year 2012 to start its implementation in 2014, with the objective of involving a larger number of companies. The results in Figure 3 and Figure 4 show that GAT model implementation increased the sales from 2012 to 2014 in 257 %. In contrast with the data between 2009 and 2012, in this period the growth expected was around 35 % (meaning no more than 70% in the same period).

The data aforementioned prove the efficiency of the model in the ARPYME development, overcoming the growth expectancy. It is necessary to mention the developing context, the enterprise growth was when the national PIB did not exceed 8 % and when the country reached a high level of unemployment. Also, the enterprise is located in a rural zone with very limited access to resources, where streets are mainly dirt roads, there are not nearby companies nor services of constant public transport, amongst other difficulties that highlight the obtained results.

Another interesting fact of the GAT implementation was the research done during the process. Many formulations, stability tests, and controlled quality tests were developed but also many innovative products were done, involving the product creation, the packaging materials and the production processes themselves. Also, the students' participation in the development of the product was promoted and academic tours were conducted to visualize the economic and social importance of the model and to appreciate the real positive change in the surroundings where it was applied.

A positive impact of GAT model is the fact it can perform not only in complex situations but also in simple specific interventions. The model can be applied for a specific technical articulation, such as an isolated need of an ARPYMME that cannot solve it, and due to a solidarity principle and model of cooperation, the model can be fixed with the sector articulation.

An example of the aforementioned situation is the validation of an analytical method for visible spectrophotometry. The ARPYMME cannot acquire a spectrophotometer to validate the analytical method of a pharmaceutical product, which in turn means it cannot be registered, commercialized nor distributed. Through the GAT model, it was accomplished for students to validate the methods using the equipment present in the laboratories, which in turn provided the company to commercialize the product and let the students use their recently acquired knowledge. This very specific support point allows the product commercialization, which benefits the ARPYMME and generates opportunities to the potential buyers. Also, the students would have missed out the opportunity to develop their theoretical and practical skills. In summary, this articulation strengthens the relationship between the company and the university, which in the future should enhance new projects development.

Among the main conclusions about the model's implementation is the fact that the model is robust, flexible, potentiates the businesses involved, optimizes resources for the involved participants, allows the students participation and provides general citizens with more options of innovative products using the most out of the provided resources and installed capacities. The GAT model allows the economic growth in different social conditions, which favor the sustainability of the model.

The same model is also applicable in specific and complex situations which can modify the model's articulation variables without changing the organization and also, can include new actors that complement the weaknesses and encountered needs.

The articulations can vary according to the context of the model's application and can involve multiple participants simultaneously. The model is very dynamic and auto-perfects itself through the transference of experience between the participants involved, generating an enhanced process of innovation.

Finally, the model has demonstrated the accelerated growth of the company in which it was implemented (as shown by the markers acquired) while also a consolidation in local markets was accomplished. However, the company must still focus their efforts in the diversification of their production means and in the indicators growth opportunities.

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