ORGANIZATIONAL DESIGN OF THE BIOEN-FAPESP PROGRAM: INTELLECTUAL PROPERTY AND TECHNOLOGY DEVELOPMENT IN PUBLIC-PRIVATE PARTNERSHIP IN THE SUGAR-ENERGY INDUSTRY.

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Abstract

The BIOEN- FAPESP is a Bioenergy Research Program which aims to articulate public and private R&D, with the object of using academic and industrial laboratories to advance and apply knowledge in fields related to ethanol production in Brazil. The Program was launched in August of 2008 and is expected to end in 2014. Despite de advancements of ethanol production of other origins, like corn, in other countries, Brazil is leader in production and technology related to sugar cane industry and the Program is a reinforcement of this position. It is well understood that the sugar cane industry is a strong sector and an exception, in Brazil, in private investment in R&D with patents to hold its position. However, cooperation between academic researchers and industry is something new here too. So, how the Program is managing those collaborations between academic laboratories and industrial interests? Secrecy and patents is a common treat in industries were private partners deals with other private partners, but, what about academic partners? Our approach is that Intellectual Property *via* patents is a legal protection strong enough to give to Brazilian researchers and Brazilian industry assurance and confidence to invest in new technologies associated to their own technological strategies. Especially if we consider economic-legal problems like Material Transfer Agreements and its implications for the development of new technologies which could face restrictions if a Freedom to Operate analysis is not done thoroughly.

Key words: Organizational Design, Technology Development, Public-Private Partnership, Intellectual Property, sugar-cane industry.

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Introduction

This working paper is organized as follows:

1) What is the Bioen-Fapesp Program with concerns about:
    1. a) Ethanol as a substitute for gasoline and other fuels for light transportation vehicles.
    1. b) Bioen economic and social context.
    1. c) Objectives, areas of research.
2) Technology development and Intellectual Property is the second point of concern which establishes in what ways the academic researchers can be linked to private enterprise interests and collaboration. Here is also presented our research method and some of our findings at the moment.
    2. a) Basic and Applied Research.
    2. b) Applied Research and Intellectual Property.
    3. c) Material Transfer Agreements and Freedom to Operate.
3) Public-Private Partnership, some insights for cooperation and coordination is the result of this researcher perspective according to the questionnaire and interviews.

1. The Fapesp Bioenergy Program.

The goal of the program has been defined accordingly: "The BIOEN program mission is to foster comprehensive academic and industry research on sugar cane and other biofuel sources, integrated with the sugar and ethanol Industry, thus assuring Brazil's position among world leaders in Bioenergy research and industry." Sugarcane bioenergy is an important clean energy alternative to gasoline for powering transport. Sugarcane feedstock for the production of ethanol has two advantages considering first and second generation technologies of biofuels. The first generation is the extraction of ethanol from juice and the molasses taking advantages from the increasing concentration of sugar in new plant breeds and new developments in harvesting and processing from a traditional development strategy in the industry. However, there is a considerable amount of energy to be extracted from bagasse and leaves because of the glycosidic linkages of cellulose and hemicelluloses which is being developed and opened a new area of R&D. There is also the strategy of creating a new kind of sugarcane, "the energy-cane" which will primarily produce biomass for extraction for the conversion of lignocellulosic biomass. This focus on lignocellulosic strategies is called second-generation ethanol (TILMILSA & SHRESTHA; 2011).

From the traditional stand point, the first generation-ethanol production, the main efforts in agronomical research and in capital goods production, like harvesting machines and biorefineries, allowed an impressive progress in productivity growth. In fact, 91 Mt of sugarcane were produced in Brazil in 1975, yielding 6Mt of sugar and 0.56M m3 of ethanol and in 2002 sugarcane production grew 3.5 times reaching 320Mt. Sugar production grew 3.7

times and ethanol production grew 22.5 times in the same period (REVERE, PERREIRA & SIMÕES; 2010).
The development of an integrated biofuel program in 1970s in response to the oil crises, called National Alcohol Program Proalcool, had the objective of limiting the energy supply constraint provide an stable internal demand for the excess production of sugar cane and counterweight variations in internal sugar prices. This long standing program turned Brazil's ethanol as the most price-competitive biofuel in the world. The ethanol cost in the Center-south region in Brazil is estimated to be US$0.23 to US$0.29 per liter. If oil prices keep above US$42 per barrel, Brazilian ethanol is cost-competitive including new projects that are being developed (SORDA, BANSE & KEMFERT; 2010).
What makes Brazil's low manufacturing expenses is the result of the following elements:

1) From the many feedstocks available, the early choice of the sugar cane production was that it was relatively cheap.
2) Land productivity and almost no need for irrigation and fertilizers.
3) Production mills are able to satisfy almost all their energy needs through co-generation power plants based on bagasse, one of the many by-products of sugar cane.
4) Several years of governmental support allowed continuous investment in research and technology development that lowered manufacturing processes.

However, during the mid-1990s on governmental support lowered and is by far the lowest financial support comparing for example to US subsidies granted for ethanol production. In fact, there was a strong deregulation in the sugarcane sector prompting a restructuring with concentration (SHIKIDA, AZEVEDO & VIAN; 2011).
Recent research, pointed out that in the South-Center region of Brazil, states of São Paulo, Minas Gerais and Paraná, technological capacities are being constructed with institutional and organizational frame work where collective action is taken precedence over individualistic strategies in a collaborative-competitive actors behavior (SHIKIDA, AZEVEDO & VIAN; 2011).
The BIOEN Program is in this context and is supposed to strength this collaboration amongst universities, technology centers and the agricultural-industrial sector within a deregulated and low subsidized sector.
There are five areas of research which The Fapesp Bioenergy Program BIOEN divided.

1) Biomass research: the focus of this area is sugarcane, which includes genomics, biochemistry, cell biology, physiology, plant breeding and most of the sugarcane farming technologies. Some other energy crops were also included, but most of the research is in sugarcane. It also includes research on organisms with lignocellulolityc activity with potential use in cellulosic ethanol production.
2) Ethanol technologies research: focus on processing and engineering which can be related to ethanol production itself or engineering simulations on various levels. The main objective is to increase productivity whilst saving energy, water and minimizing environmental impact. It includes also engineering, processing and equipment design related to cellulosic ethanol.
3) Alcoholchemistry and Biorefineries: integrated focus on sugarchemistry, alcoholchemistry and bio-products. Very promising area integrating bio-plastics and

several products that can substitute petrol products with high ecological advantage. The main objective is to substitute, as much as possible, fossil derivative compounds.

4) Engines: focus on ethanol applications for motor vehicles: Otto cycle engines and fuel cells. The technology of *fuel-flex* was developed and patented by Bosch-Wolkswagen and is in areas of research the one with the fewest participants. Recently, Embraer, the national aviation production company, became interested in participating in the development of aviation fuel. About fuel cell, ethanol is a promising short cut.
5) Impacts: focus on social, economic and environmental studies, land use, intellectual property associated with the biofuel industry. This study is in this area of research.

2. Technology Development and Intellectual Property.

The BIOEN Program is sponsored by a government agency that until recently was traditionally concerned with academic financing only. Now, programs specially designed to foster R&D in firms of all sizes is offered (PITE; PIPE), partnership between universities and companies are stimulated and patents are accounted as much as published papers when researches file for financing.

Usually, the divide between basic and applied research helps to identify which areas should be financed by government support and which should be left to market and enterprise initiatives. Basic research is, by "nature", a public good with difficulties for appropriation by individual firms or because the knowledge implication is of public domain. Applied research, on the other hand, has "higher" appropriation mechanisms which can lead to sustained profits and, therefore, need less governmental support. This simple schematics has been challenged and not only private initiative can reach what was once viewed as basic research but government also can, and some times has to, finance what was viewed as applied research; the reasons can be the effort for the development of certain sector, the high "spill over" effect or national security measures (DASGUPT & DAVID; 1994).

The divide is also less and less settling when we consider that the advancements in basic research and the competence building in and around technology intensive sectors, and this is much clear in the BIOEN Program, go beyond laboratory walls and reach out society at large. Science and technology is every day closer and science advancement depends on technology development and technology development depends on science advancement. This means that goods and services and its social reprecautions are subjected to social evaluation in a holistic level which engage government and private initiative in a much more complex manner. This settles for a coordination action with is a collective action approach (PAVITTI; 1990).

The scenario for appropriation in this complex environment poses one of the many alternatives for private firms to profit, develop and invest in technology and science. Bioenergy is certainly one of this complex setting were many alternative technologies are open and many interests are at stake implicating in a certain level of arbitrage between public interests and private profits. Environmental issues, land use, food price are of, evidently, public interest. But is also technology "spill over", development of human capital, rise in the average income and rural development. From the private point of view, the profit returns has to be attractive and the economic and political settings has to be stable enough (AGHION, DAVID & FORAY; 2009). The intellectual property arrangements is one of these settings

that is supposed to give stable scenarios. For example, from the total patent deposits in INPI related to sugar cane and ethanol production we find that 68% from 1974 to 2006 are Brazilian holders. However, biotechnology related patents are held by EUA and Japan which point out that the BIOEN Program is well directed to areas that is necessary to improve (WINTER, LIMA & MENDES; 2010).

This focus on national patenting considers that sugar cane and ethanol production is nationally related specially because of cost-effective achievements. Disregarding that technology developments are being held in other countries also, with interest in developing technology for sugar cane and ethanol production not for internal use but for technology commercialization and for that patenting all around the world. This behavior sets the problem of Freedom to Operate analysis which is the study and management of products technology process by patent analysis unraveling patent claims that compromises your own product or technology if there is a patent over it. Freedom to Operate is exactly freedom to hold all claims around your patent. To hold all that comes in the Material Transfer Agreements. In biotechnology and others scientific fields of research which is gaining increasing market value and where basic research and applied research is less and less discernible scientific materials, like germoplasma, patenting is gaining terrain within scientific materials. To have freedom to operate you have to have good agreement which is a fair share out of product development and commercialization.

Which comes to our research problem: our research problem is to find out how much are the researchers in the Bioen Program aware of their patentability concerns and in what ways they find that the partnership with the industrial sector is happening. In other words, the academic effort that is being coordinated in these areas can respond to an increase in patent and private partnership for the maintenance for the Brazilian leadership in sugar cane ethanol production?

Method Summary

To carry out our research, we applied a questionnaire to 42 out of 72 and counting. The application of the questionnaire was done with an open interview taking notes and it was also recorded when possible. The researcher had/have no control over the environment in which the questionnaire and interview takes place. It was applied to the research leader because it is assumed that the scientific developments and technologies derived are under the responsibilities of those research leader and that they answer to Fapesp and the industrial sector if a partnership is established. The questionnaire is a Likert scale which means that it is a perception questionnaire working on a direct exploration strategy to convey a reasonable scenario. Especially considering that the action of those scientists are directed to the future possibilities that they believe now. The open interview is the opportunity for the research leaders to give their opinions about the effectiveness of patenting their research findings, if they think it is appropriate, if the program was adequate to accomplish its mission, and many others questions related. This research initiative and approach has never been done before in Brazil. To question and interview scientists to find out what they think about patenting their research and the adequacy of research guide posts to accomplish a mission which has socio-economic implication is new and has an institutional changing character with many scientific and economic implications.

Some Results:

Because this is a working paper on an ongoing research, we take the liberty of presenting only some of our partial results which will in the near future be better organized and with full disclose.

Some of the results that we found: Do the researchers have interest in patenting research results? When the researchers where asked about their interest in patenting the result of their research in Bioen Program, 65.2% confirmed their interest with the remaining 34.8% asserting no interest in any patent. The researcher was not asked if he/she knew is patentable or not.
The researchers were asked if the program was concerned about intellectual property and around 50% agreed that it is with about 35% saying that it is not.
Partnership with industrial R&D is perceived as important for BIOEN researchers by 86%. But about 50% believe that these partnerships are not happening as it should or could. Another question was about the purpose of BIOEN as a way to produce science and technology for the sugarcane industry. The remarkable result was that about 60% agreed with this perspective signaling for open collaboration.

About partnerships with industries in the sector we can present the following table:

	Number of projects	Area of Research	Area of Expertise
Brasken	4	Biorefineries	3 engineiring; 1 bilogical science
Oxinteno	1	Biorefineries	chemical engineering
Vale S/A	3	Biorefineries; Motors; Ethanol tecnology and industry	Engineering
Microsoft	1	Interdisciplinary	Systems technology; artificial intelligence
Dedine	1	Ethanol tecnology and Industry	Engineering

3. The main insight for collaboration between academic researchers and industry.

The most important insight is that the majority of academic researchers are willing to collaborate with industry researchers in scientific bases with very little impediments. The industry, on the other hand, is the most suspicious and take many actions that turn collaboration difficult and break the confidence. But the administrative and legal frame work of universities and research institutes also creates many difficulties.

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