

Model for the Software Industrialization in the Coffee Triangle of Colombia

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Abstract–The model for the Software Industrialization in the Coffee Triangle seeks to establish a productive alternative to the growing of coffee. This model will permit the economic and social development of the so called “Coffee Triangle” located in the central part of Colombia in the Andean region, composed by the departments (states) of Caldas, Quindío and Risaralda. Through the consolidation of the software industry which is knowledge based, the lessons learned from the successful endogenous knowledge of the Coffee Triangle Region should be present in such a software model. Also successful International Software Models from other countries are being used to establish an international software industry in the Coffee Triangle of Colombia.

Index Terms–Quality, market, technological surveillance, research and innovation, infrastructure and info structure, entrepreneurship social responsibility, politics, Software Industrialization Model.

I. INTRODUCTION

As one of the main sectors of the 21st century economy, the software industry has been consolidating. According to [1] in the next 10 years, USD 18,180 billion will move to various sectors such as virtual education, electronic government, digital convergence, Web 2.0 and Web 3.0, entertainment, business and contents generation, among others.



Figure 1. Industry Projection around ICT (Information and Communications Technologies)
Source: [1]

The software industry as well as the countries that have been successful in the software business such as India, Ireland, the United States, China, Russia, among others, have been characterized for instituting short, medium and long term programs; with the purpose to strengthen their technological infrastructure, tax incentives, and enhancing academic training. In addition, quality assurance models, have been incorporated as well as various ways to attract foreign investments.

A software industry model is proposed, for the Coffee Triangle Region, based on endogenous strengths (knowledge) [2] and with international elements referenced from countries that now are leaders in this promising software industry.



Figure 2. Software Industrialization Model

Figure 2 shows the model under a systemic approach where each element or component is interdependent and at the same time it is interrelated with the others. This is symbolized by the blue color blaze representing the interconnections between the sub-systems of the model. In addition, the knowledge item is presented in an integral and transversal way in the whole model, since the software industry is considered a knowledge industry, which is precisely the aim proposed by the Coffee Triangle Region. [3]

This scheme is proposed without limits. It is an open system and in tune with the environment. The scheme is dynamic and able to adapt to the changes generated by the market as well as being innovative. Due to the increase demand of information and the entertainment needs of a changing world the situation requires using a device that is within reach on line with the world.

II. GENERAL DESCRIPTION OF THE COMPONENTS

A. *Quality*

The issue of Quality becomes a transversal component in the software industry at any level. Until recently this Quality element differed in value in the software industry. However, because of the developments in the software industry at the worldwide level, this quality component became a minimum requirement to satisfy the great global demand of software products and services. Also the quality component became a requirement for the public and private sectors at the local and international levels.

The Software Quality can be defined as the level in which the software has a defined and desirable articulation of quality [4]. A number of interdependent and interrelated elements, which when treated in a transversal way with quality alignments, can reach the proposed objective in an efficient an way. The manner in which quality components can be incorporated into Quality Software are many and varied; for example, it is necessary to consider the fundamental role of computer programs. Without an instruction list defined by a programming language, computers are useless [5]. The programming methods, the new tendencies, etc. are elements that must be considered and addressed when discussing Software Quality.

The products and services demand related to the Information and Communications Technologies (ICT), especially in the software field, has increased in recent years. This increase has taken place in Companies as well as in other Organizations. The intensive use of ICT technologies have become a key factor; when they are properly managed and add value to the Organizations and Companies [6]. The Software Quality is a required characteristic for software products and services.

The subject of Metrics or Software Measurements for Quality models are given some importance. In this case, one may consider this subject as one of the key components for Quality. The need for measurements has been evident from the beginning of history in most of the technical or scientific activities, as a mean to evaluate, control or predict. It is clear that Software Engineering is no exception.

The philosophy of Software Engineering implies a clear interest to control and predict software development and maintenance. In addition, the software engineer can use measurements to help evaluate the quality of work products and to help in technical decision making as a project evolves.

It has been difficult quantifying or measuring the effort or quality of work done on different projects. It is necessary to do better planning and projections in the development of new projects. There are many problem issues involved in the Software development process, issues such as incorrectness, decision makings, lack of quality control, excess expenditures, maintenance and evaluation costs of new methods. Therefore, measurements help to improve some of the above mentioned problems by having verifiable requirements expressed in measurable terms, and quantifiable evidence to support decisions. Also measurements offer development of early identification of problems, making justifiable cost and time predictions, testing strategies and identification of problem modules, as well as assessment of the impact on productivity and quality.

Nevertheless, the problems generated by software development have not been declining, on the contrary, they have increased and every day new problems emerge as new tools and technologies are used. The failure to meet deadlines for delivery and the increase in software costs are the rule rather than the exception.

Today it is unthinkable for any business to improve in a consistent manner without having a quality control process since it helps to better planning, management and control of processes in the surrounding environment

B. *Market*

Market development must be understood as integral part aimed to the acceptance, placement, use and consumption of products and services offered by the software industry to the segments objective. This implies that market actions be articulated in a Market and Sales Strategic Plan.(MSSP), which will serve as a guide for commercial activities. Below are the basic elements for this construction.

Elements for the construction of the MSSP. The analysis of the following information must include strategies of competitive advantages in industry development. Next are the basis elements that will lead to the construction of the MSSP for the Software Industry in the Coffee Triangle [7].

BUSINESS MODEL			
Basic Entrepreneurial Function – BAF	Value Proposal – VP	Business Logic – BL	Technological Solution – TS
VISIONS INVENTORY			
Mission	Vision	Reference Models	

Figure 3. Conceptual Bases Market Plan

Strategic Bases. An essential tool for strategies identification is the Analysis of Competitive Forces, by Porter, in carrying out this issue. It is supported by the concept, that software industry is to defined its strategic behavior according to forces in the competitive sector.

Quantitative Bases

- Targeting
- Segments, Prioritization and Definition of the segments objective. Market segmentation is one of the most important analytical tools for the design of a market and sales strategy. This resource is also essential in the technological market, since technological solutions serve specific problems issues to users. The technology market can be considered a solutions market, where the process of segmentation becomes very demanding.

Financial Bases

- MSSP Costs
- Definition of Budget

Technical Bases

- Negotiation Schedule
- Punctual Strategies (Support Events)

C. Technological Surveillance in the Software Production - TSSP

The Technological Surveillance for Software Production (TSSP), refers to the need to consider the new tendencies for the software development on an industrial scale.

“The technological surveillance is an organized, selective and permanent process to capture information from outside and inside the enterprise about science and technology, to select it, analyze it, disseminate it and communicate it, in order to convert it into knowledge to make decisions with less risk and to be able to anticipate to changes”. ESI Andino Center.in Bogotá.

The global software industry is presented as an opportunity for the Coffee Triangle regional development. It has shown rapid development in the last few years, which has influenced all the other economic sectors. This has allowed opportunities for specialized development enterprises.

To achieve a competitive position, in the market, requires the software companies to have efficient management that incorporates critical success variables such as time management, cost controls,

and quality control processes, knowledge of specific market niches and knowledge potential opportunities in the regions. In this way the specialization of the Coffee Triangle software industry will become a uniquely competitive.

D. Research and Innovation

The Software Industry requires on going innovation at the global level, not only of processes but also of services. However, the starting point must be research, in other words, research that sustains innovation allows for changes and transformations with scientific support.

A fundamental element considered in the international context is the scientific and technological development in Colombia. For this reason the Research and Development (R+D) investment is measured, by investment in science, technology and innovation activities (STIA). The sum of the investment in R+D, advanced training, scientific and technological services and innovations are activities that contribute to scientific and technological development. Thus according to data given by the Science and Technology Observatory the investment in STIA reached in 2005 0.52% of GDP (Gross Domestic Product) in Colombia, and in 2006 went down to the 0.47%. while the investment in R+D as GDP percentage has been stable for the last four years, around 0.18%, much lower than the rates of the leading software industry countries.

E. Infrastructure and Info-structure

The ICT has contributed to a great extend to the development of a country.

“Connectivity refers to the global interaction between the infrastructure of ICT of a country, incorporation of the telecommunications as well as the hardware and software systems and the final users, including the varied abilities people need in order to obtain the best use of tools” [8].

Infrastructures are the communication networks, people, training investments and the complementary assets, such as servers, internet hosting and software.

The first survey of ICT's was done by DANE¹ in 200. In 2008 there was a compilation of indicators related to ICT penetration levels in homes, industry, commercial and services enterprises as well as micro establishments. These micro establishments were also studied during 2006 and in 2007 in 13 metropolitan areas of Colombia.

“In 2008 83.8% of Colombian homes had cell phones compared to 17.7% in 2003. In the capitals of the departments of Colombia 87.5% had cell phones in 2008 compared to 21.7% in 2003. The remaining population the percentage went from

¹ National Administrative Statistics Department

4.6% in 2003 to 70.8% in 2008. In 2008, 77.2% of Colombian homes where the head of household earned between 0 and less than 1.5 minimum wage had cell phones, while in homes where the head household received more than 1.5 minimum wage, cell phones exceeded 90%.” [9].

F. Association

An association is where individuals, enterprises or communities cooperate, assist, and join together in search of a common goal.

The association models have been present in man’s evolution, which aims to look after the individuals’ wellbeing on behalf of a community. *“However, the association models in the Enterprise field are not so generalized mainly for the lack of incentives by government and because of the lack of cooperation existing in most of PYMES (Small and Medium Enterprises)”* [10].

Some government organizations and private sector organizations have made an effort to encourage the grouping of enterprises, but to achieve this requires a radical change in the Regions entrepreneurs as well as some training in the existing models of enterprise association.

G. Entrepreneurship

Entrepreneurship becomes an opportunity to nurture the Coffee Triangle Software industry with skilled workers taking advantage of the number of Educational Institutions that are training professionals in the ICT area.

In Colombia, the Entrepreneur Activity Rate (EAR) was 24.52% for 2008, represented by distribution of new entrepreneurs equivalent to 13.82% and new businessmen 11.73%. These numbers indicate that the entrepreneurial activities of Colombia have been manifesting with a lot force. The percentage of enterprises that have participated in “medium” or “high” technology activities is 7.42%, which demonstrates that Colombia and Uruguay are the countries with the highest results in this sector for all of Latin America. This positions Colombia at one of the highest levels in the world.

Colombia ranks near the top worldwide when comes to entrepreneurship, similar to other Latin American countries. Bolivia and Peru ranks second and first respectively. Another very important indicator is that 92% of the Colombian population considers entrepreneurship a desirable career alternative, in other words, entrepreneurship is an activity that generates social recognition. Colombians view entrepreneurs with high status and respect.[11]

The Law 1014 was approved in Colombia on the 26 of January, 2008; this law seeks to promote the Entrepreneurial and Entrepreneurship culture at the

National level. The national government of Colombia has assumed a definite commitment to Entrepreneurship; for the Software Industrialization Model of the Coffee Triangle this is fundamental, since the business ideas generated towards new software products and services, must be part of the Industry. Also Entrepreneurs are encouraged to develop their enterprises with this model.

Another fundamental commitment of the national government was creating the National Entrepreneurship Network(NEN). The NEN defined institutional and individuals responsibilities that would guarantee the fulfillment of NEN proposed objectives. Such National Network was subscribed directly to the Industry, Culture and Tourism Ministry of the country.

H. Government Policies

After analyzing the countries that are leaders in the Software industry, we can affirm that software development would not be possible without considering Government Policies.

Government policies have been a fundamental component in software development.

In Colombia different governments have various policies towards the important Software Industry, where Presidential Directive 02 of 2000 [12], could be considered as the “cornerstone” of such policies. These policies are in line with the infrastructure theme in ICT, including the Compartel Project that allowed Internet connection in the entire country.

This has gone a long ways towards the Technological and Infrastructure ICT development with strong elements such as the Information and Communications Technologies National Plan (ICTNP) where “The National Government has considered strategies centered in ICT to promote competitiveness and equal opportunities in Colombia. Therefore, the national government has set as a target in 2019, all Colombians are connected and informed using the ICT’s to improve social inclusion and competitiveness. These goals will be achieved by assigning resources and moving fundamental individuals.

During the Planning process, meetings were held with different bodies of the public and private sectors, the purpose was to achieve coordination and alignment with the Colombia Vision of 2019. In addition, other organizations such as the National Development Plan 2006-2010, the National Competitiveness Policy the Science and Technology Plan, and the Strategic Program for the Use of media and Information and Communication Technology were taken into account.

The most important support and promotion of the Colombian Software Industry has been the National Government, through the Culture, Industry and Tourism Ministry. The National Government

considers the software industry a strategic sector, where the business plan was to develop and promote the Software Industry in Colombia.

Another Government Policy fundamental to the Software Industry, is the Science and Technology Policy. Since knowledge and its varied applications are central elements for the economic and social development of today's industries, these industries have recognized that economic power is a differentiation factor improving their competitive position in the long term.

This policy is a relevant element for the Industrial development.

This policy was started in 1990 when the goal was to improve productivity and competitiveness in software Industry. This led to the development of a legal and institutional framework that would strengthen the innovation and technological processes. From this the National System of Science and Technology – NSST- was created (Law 29 of 1990 and the Decree 585, 1991) and the National Innovation System – NIS- (Conpes 2789, 1995) in which both seek the integration of different entities such as government, the private sector, and academia, etc.

In the early 1990's this policy was carried out by integrating the private sector with the Science and Technology (ST). Through private sector participation in eleven national councils who were established to formulate policies. In addition, these policies sought to support the training of human resources and the joining of international networks of Science and Technology (ST) (Conpes 2739, 1994). From 1994-1998, known as the "Sages Mission" period the national government proposed to integrate ST to the various sectors of Colombia. The proposal sought to increase the competitiveness of the private sector in the context of an economic internationalization policy, thus improving the welfare and lives of the Colombian people (Conpes 2739, 1994, p.4). Additional measures were taken to increase public and private investments in S and T. Conpes proposed increasing the GDP by 0.5% in 1994 up to 1% in 1998. After this, the Technological Development Centers (TDC), the Enterprise Incubators of Technological Base (EITB), the Productivity Centers (PC) and the Technological Parks (TP) were born.

Financial and investment tools were also generated as "Seed Capital" (Capital Semilla), as well as co-financing funds, the tax incentives for investments and risk capital funds.

Through Conpes 3080 for the year 2000 a policy framework was formulated to strengthen the NSST from 2000-2002. It was proposed to expand and consolidate former objectives and strategies with other national goals to take advantage of Colombia's development of Information and Communications Technologies (ICT).

The National Fund for Productivity and Competitiveness was implemented as a source for innovative financing. Finally, Conpes 3280, proposed in 2004 to improve support for enterprises by the coordination and consolidation of information. Also it proposed the monitoring and assessment evaluation of the results. However, these proposals were not widely implemented in the country; because they were poorly understood by the private sector there was little use. Making difficult for the private sector to respond to globalization. Facing this situation Law 1286 based on Science, Technology and Innovation was created in order to strengthen these activities in order to become the basis of the National Competitiveness Policy.

In addition, it is necessary to recognize that the knowledge formulated by the Vision for 2019 for Science, Technology and Innovation must be produced, and integrated into the social transformation of Colombia. For this reason it is very important to introduce technology management issues into the entrepreneurial sphere. Since entrepreneurs are prominent in a knowledge society, therefore it is necessary to make appropriate decisions and actions that strengthen technological development in Colombia.

The government sector has given the biggest boost with laws and regulations, that has incentivized Colombia's economic development as well as the success of the Software industry.

I. Entrepreneurial Social Responsibility

The Entrepreneurial Social Responsibility, ESR, is the capacity of an enterprise, entity or organization to maintain in balance and an adequate satisfaction level between entrepreneurs, employees, customers and suppliers, etc. (shareholders of interest groups). An Enterprise or Organization is considered socially responsible when the activities are oriented towards the satisfaction of the needs and expectations of those persons inside and outside the enterprise or organization. This social responsibility has become a leading issue for enterprises due both to the demands of the market and the increased awareness towards the social and environmental problems and challenges that humanity faces as a whole [13].

Entrepreneurial management considers different scenarios such as:

- Normative, this component is integrated by the set of general laws and regulations that the different governments implement to regulate the functioning of enterprises and markets.
- Operational, considers the elements related to the production of goods and services according to the objectives and goals of the enterprise.
- Economic, considers all the micro and macro economic variables that affect the profitability

level of the Organization, such as expenditures and sales, etc.

- Social, this component is directly related to the issue of the ESR, as it seeks to meet the needs of the different persons enabling them to contribute to the quality of life and welfare of Colombia.
- Environmental, this component is also related to the ESR, since it refers to the environmental impact, environmental protection and sustainable development.

The Entrepreneurial Social Responsibility, ESR, considers the development of an organization, since it cares for the quality of life of all the persons that interact with the Enterprise, but also caring for the environment. The ESR seeks to balance, the welfare and the responsible use of the resources looking for the planet conservation.

The Software Industry in the Coffee Triangle Region has developed very few products and services that have improved the conditions in the agricultural sector. Despite the numerous Universities in the region there is no evidence of innovation and research in software products. One of the reasons for this lack of innovation and research is that there is no close relationship between the Universities and the Industry in general. In addition, software development companies work independently[14].

Taking into account these local realities we propose, a world class Software Industrialization Model using the endogenous human talent skills, the social needs as well as the political and institutional factors to develop the region.

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