

# KNOT - A PEDAGOGICAL PROPOSAL FOR LEARNING THE STRATEGIC PLANNING FOR SOFTWARE COMPANIES

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## ABSTRACT

*Strategic planning seeks organizational development through the formulation and implementation of projects oriented to reach corporate objectives for middle and long term. This paper presents KNOT, a pedagogical proposal for learning the design and implementation of strategic business planning (SBP) and strategic computing planning (SCP). KNOT is based on pedagogical and management approaches, and it focuses on software companies by including four elements: (1) a simulated software company as a virtual learning scenario, (2) the formulation and implementation of SBP and SCP, as application guide, (3) a role-playing game as an active participation strategy, and (4) LARIAT prototype software, as a tool that implements the process and supports the proposal. Currently, LARIAT is being tested in the software engineering courses at the University of Nariño.*

## INTRODUCTION

Organizations of all types engaged in various economic activities take SBP as a mechanism to ensure their validity in the market and sustainable growth. SBP is a management tool that seeks organizational development through the formulation and implementation of plans, programs and projects in the scope of corporate objectives; thus, SBP looks for optimizing the use of resources and investment efforts. In this way, individuals, groups, and areas of the organization focus on projects that are part of the strategic planning. SCP is the set of plans, programs and projects from information technology support to SBP.

Locally and worldwide, software industry has gained importance in terms of social and economic growth; in addition, several companies in the region that are integrated

into national contexts are working with SBP. New scenarios require that these organizations incorporate administrative approaches into their practices, which enable productivity and competitiveness levels in order to stay current in the global market.

Software industry demands the academy transferring knowledge to incorporate into their management practices on SBP. In, requires a pedagogical approach that facilitates learning of the formulation and implementation of strategic projects aimed at achieving corporate objectives in software companies.

For constructing SBP and SCP, it is necessary to make a set of analysis tasks, requiring confidential information about a specific organization. With this in mind, few organizations are willing to share information for academic purposes. In response to the software industry requirements and taking into account the difficulty to cover the learning process in real contexts, this paper presents KNOT as a pedagogical proposal for learning strategic computing planning for software companies by following four steps: Firstly, the creation of a simulated software company as a virtual scenario for learning. Secondly, it is created an application guideline for formulating and implementing SBP and SCP. Thirdly, it is required a role-playing game as a strategy for active participation in teams. Finally, LARIAT software is presented as a tool for implementing the theoretical proposal. It is important to note that LARIAT is currently a prototype, and it has been tested in courses of software engineering at the University of Nariño.

This paper shows a theoretical framework about both administrative and pedagogical approach. Then, it is described the components of KNOT and its experience within software engineering courses at the University of Nariño. Finally, it is presented future works in this regard, with the reflections in final conclusions.

## STRATEGIC BUSINESS PLANNING

Strategic business planning arises in the 1960s for attending special needs from the business sector in the United States of America; SBP reaches its top status as a management model in the 1970s, and now it is widely recognized as the most used guiding mechanism for organizational stadiums (Díaz & Cuellar, 2007).

### DEFINITIONS

Some authors, such as Amorocho (2009) and Ackoff (2004), have directed their efforts to the study of strategic planning for both business and computing in order to produce proposals for its formulation and implementation in real contexts. Here are some definitions referenced in the administrative field since the view of the academia and industry.

Strategic planning is a management method that provides managers with a means by which to anticipate and cope with internal and external changes, and therefore, to develop appropriate strategies for an uncertain future, so as to enable the organization to achieve its objectives and tasks (Matos, 2005).

Recalling Ansoff, Declerck and Hayes (2003), strategic business planning can be understood as an administrative tool that is setting the organizational mission and vision, followed by the diagnostic analysis of the strengths and weaknesses of the organization as well as the opportunities and threats, in order to set objectives and projects that enable the organization to fulfill its established mission and vision.

Steiner (1991) defines strategic planning as the process of determining what are the main objectives of an organization and the criteria that preside over the acquisition, use and disposal of resources in terms of achieving the objectives referred. A strategic planning process encompasses missions or purposes previously determined, and the specific objectives sought by a company.

De la Rosa and Carrillo (2010) declare that strategic planning is a set of actions that must be developed to achieve the strategic objectives, which implies defining and prioritizing problems to solve, develop solutions, identify people who are responsible to carry them out, allocating resources to carry them out and set the manner and frequency to measure that progress.

Additionally in a specific point of view, strategic computing planning (SCP) is the set of elements that supports the formulation and implementation of projects in order to reach the strategic objectives and are part of the SBP. In this vein, SCP integrates projects regarding technology infrastructure provisioning, software provisioning and technical support to the operational and administrative processes of the organization (Barón, Castillo & Insuasti, 2012).

In this logic, different authors propose different

definitions of strategic planning; however, it is possible to infer a set of elements that represent the conceptual essence of strategic planning: the vision of the desired state is the image guide of the process, the systematic approach in the internal relationships of the organization and its environment, the resources to address specific purposes, an active operational position, the definition of terms or timetables, and the organizational commitment of top management among others.

### METHODOLOGIES

The way about how the strategic planning is conceived is the result of the development of management models that provide different ways to strategically plan. These models are constructed according to certain precepts that define the nature of strategic planning. Some of these precepts are: strategic planning is a management tool created with the ultimate goal of maintaining or increasing the profitability of a business, strategic planning should be developed in the administrative leadership and should be a permanent feature of this level, the strategic planning process supposes a separation between planning and implementation of the strategic objectives. The implementation of the strategic objectives presupposes that organizational structure must conform to the provisions of these objectives, and strategic planning defines the future development of the organization. (Ansoff, Declerck & Hayes, 2003).

There are several methodological approaches to formulate and implement strategic planning in an organization. These proposals are the theoretical and practical basis for defining the process that is part of KNOT, some are listed below.

Martínez (2003) presents the formal strategic planning process that integrates the following activities: formulation of goals, identification of current objectives and strategies, environmental analysis, analysis of resources, identification of strategic opportunities, and determination.

The model for the design of the strategy proposed by Sallenave (2010) consists of the following steps: Determining the mission, analyzing the SWOT matrix (Strengths, Weaknesses, Opportunities and Threats), identifying key facts and action stages, determining outcome areas, developing objectives, defining strategies and action plans.

David (2003) presents the model of strategic planning with the following phases: translating what are the embodiments of the company and what are the strengths and weaknesses, immediate action, classification of company goals, know the environment, know the expectations, evaluation of alternatives, and preparation and implementation. In the same way, Álvarez (2006) proposes a set of activities with more detail: setting goals, developing the company philosophy, developing policies, planning the structure of the organization, providing staff, establishing procedures, providing facilities, providing capital, establishing standards, establishing management

programs and organizational plans, providing controlled information, and motivating people.

According to the analysis of the models of strategic planning, although activities are named and treated differently are essentially the same. In general, the activities in SBP can be categorized as analysis activities and implementation activities. Analysis activities focus on defining and diagnosing the organization; they define strategic objectives and projects for the achievement of those objectives. The analysis activities allocate resources to identify responsible. On the other hand, implementation activities are focused on implementing the plan and monitoring such implementation.

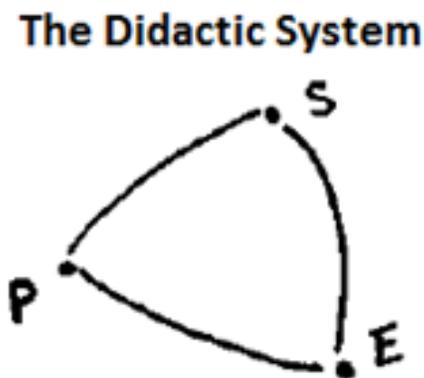
## PEDAGOGICAL APPROACH

### Theory of Didactic Transposition

Didactic transposition is the phenomenon by which the professional content (scientist, scholar, or expert knowledge) is transformed into feasible content to be taught (Chevallard, 1985), not only by simplifying or eliminating some difficult or abstract features, but rather by a more complex process that shapes professional knowledge to be adapted to the educational context due to conscious and unconscious actions of who is designing and teaching.

Everything starts with the recognition of an integrated triad that represents the didactic system; this triad is composed by the teacher (P), the student (E), and the knowledge (S) as it is shown in figure 1. Knowledge is also part of the didactic system, and it is considered as objects in such system; however, those objects experience changes due to the phenomenon.

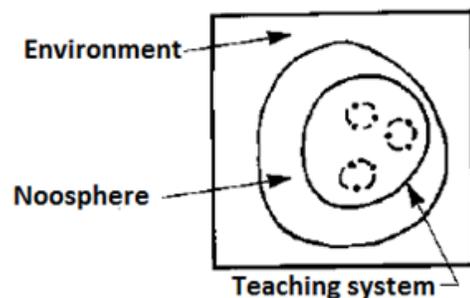
**FIGURE 1**  
**THE DIDACTIC SYSTEM**  
(CHEVALLARD, 1985, P. 26).



According to the theory of didactic transposition, when knowledge (expert, scholar or professional knowledge) is carried toward an educational setting, its objects experience

transformations due to the noosphere (the place where educational issues are thought and designed) and the exercise of teaching itself. Figure 2 shows the scenario where such transformation of knowledge takes place; thus, a set of didactic systems are immersed into the teaching system for a specific context. The teaching system belongs to an educational institution, where the noosphere makes decisions regarding the contents to teach. In addition, everything is embedded in an environment with specific features.

**FIGURE 2**  
**TEACHING SYSTEM, ITS**  
**ENVIRONMENT AND THE NOOSPHERE**  
(CHEVALLARD, 1985, P. 28).



In essence, knowledge “suffers” three transformations through separate objects: the knowledge object (the original expert knowledge), the object to teach (that represents a selected content to teach in educational settings) and the teaching object (that represents the knowledge in direct interaction with students within a classroom; in other words, the knowledge put in practice via teaching).

Based on Chevallard's theory, this paper shows a customized view of the phenomenon with the addition of new items in accordance with the Computer Science Education scenario. In this vein, the definition of the noosphere is quite relevant in teaching SBP and SCP because professors should have a close relationship with industry in their local contexts. Since a pedagogical viewpoint, the creation of a simulated software companies involves several educational challenges in terms of approximation to the reality. That's why the theory of didactic transposition is highly valued within the constructivist paradigm due to the creation of the specific space for allowing students to construct their own software enterprises.

Taking into account the educational setting of higher education, this proposal is based on the principles of Problem-Based Learning with interesting elements of active learning, allowing students to participate in active work sessions with a simulated labor environment. Thus, the noosphere in the teaching system should be formed by the professor with the support of some recognized

individuals from the local software industry.

## THE PROPOSAL

The difficulty of access to the software companies that students have with the purpose of obtaining information about business processes and strategic computing planning, requires that the professors include in their pedagogical approaches innovative strategies to overpass such difficulty. In this manner, students are allowed to learn through a practical approach the formulation and implementation of strategic thinking in an organization. That's the main reason for creating of spaces in order to simulate a software company because locally is not so easy to get access in real software companies.

This research work presents KNOT as a pedagogical proposal which is composed by four elements. In general terms, such proposal is shown in figure 3.

### SIMULATED SOFTWARE COMPANY: A VIRTUAL LEARNING SCENARIO

The simulated virtual organization is the scenario in which students assume administrative roles in this light and recreate situations faced in a real process of formulation and implementation of strategic thinking in a company.

The simulated organization is defined by students from research on organizational profiles of software companies. In a pedagogical context, such creation is reviewed by the noosphere of the teaching system (the professor and some professionals from the industry). The creation of a simulated business involves defining the elements of corporate identification such as name, type of business,

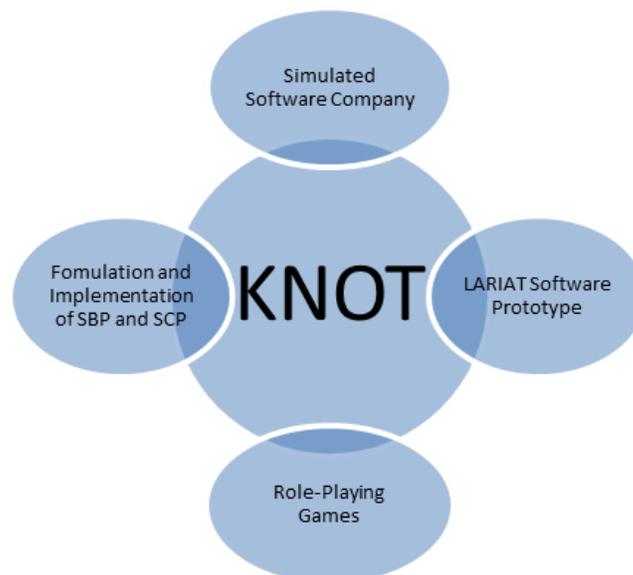
products and services offered, the mission and vision, the elements of context, as the target market, the coverage area and businesses competition, the organizational structure with the corresponding functions of individuals and units; production processes, administrative tasks and marketing. To this purpose, KNOT has a number of formats and guidance documents provided by the professor as part of the course's educational resources. It is important to note that such educational resources are based on templates which have been produced by the noosphere within the context of problem-based learning. At the end, once defined the organization, students distribute administrative roles to be played during the experience in accordance with the provisions in the formulation and implementation of strategic planning, which is the KNOT's application guide.

### THE FORMULATION AND IMPLEMENTATION PROCESS: KNOT'S APPLICATION GUIDE

The application guide is the mechanism that allows guiding students in applying KNOT, setting inputs, outputs, and processes responsible for each step. The process of formulation and implementation of strategic planning according to KNOT includes the following steps: (1) Defining the elements of corporate identification. (2) Diagnosing organizational area. (3) Integration of diagnosis. (4) Tuning. (5) Documenting SBP. (6) Project Selection and Classification (7) Documenting SCP. (8) Defining of development tasks. This application guide can be seen in figure 4.

At the moment of defining the elements of corporate identification, student teams establish the corporate name of the company, type of business, economic activity, offered products and/or services, customer target, and

**FIGURE 3  
KNOT PROPOSAL'S COMPONENTS**



market objectives of the organization, area coverage, some economic indicators describing the financial status of the organization, mission, vision, organizational structure, roles of individuals and areas that students find relevant. This step is performed in a group and is led by the student who has the role of coordinating the strategic planning process.

Diagnostic of organizational area is the identification of internal business elements (strengths and weaknesses) and external business elements (opportunities and threats) also desired transitions are constructed (i.e. action plans that allow students to define: transform weaknesses into strengths, maintain or increase strengths, seize opportunities and deal with threats). This step is performed using data collection tools such as survey, interview, document review and/or direct observation, participation strategies are also used as brainstorming. The diagnostic area is led by each of the principal area students. This activities are conducted by an active learning approach, and all the materials and resources are also previously designed by the noosphere in accordance with the teaching system.

Diagnosis integration is the step by which the set of specific diagnostics made by each organizational area, which it is produced a holistic diagnosis along the entire organization. This stage is led by the student coordinator of the strategic planning process.

Tuning is a workshop session that simulates a meeting attended by the directors of each organizational area, senior management and the coordinator of the strategic planning team. This stage uses as input the comprehensive diagnosis,

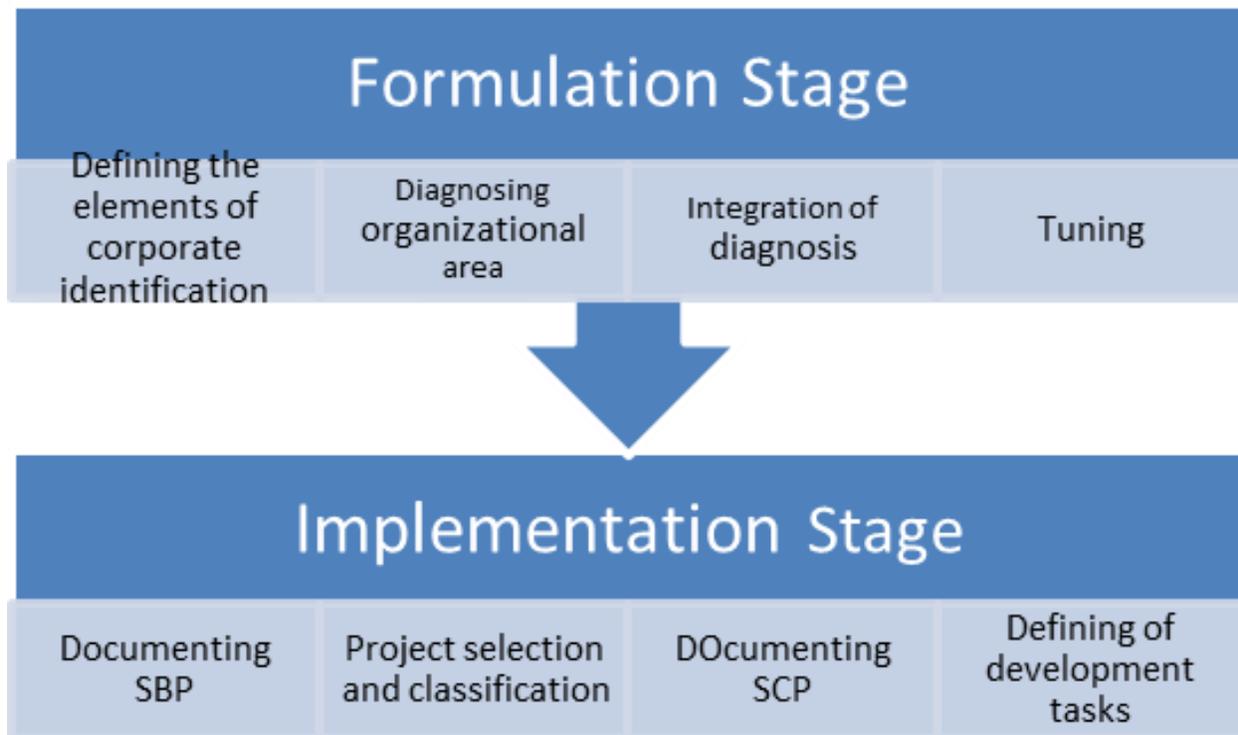
which is analyzed and discussed. Outcome of the discussion at this stage, it is identified what transitions should be eliminated, supplemented, modified, merged or divided. In addition, resources are allocated, times are defined and it is assigned the responsibilities. The result of this step is the set of desired and concerted transitions at management level of the organization that later become the SBP projects.

SBP documentation consists of the construction of a control panel, at this point the desired transitions defined in the tuning stage are defined as projects. The document must be approved by senior management of the organization. Using as input the SBP documentation, selection and ranking of projects consist in identifying those projects that are directly related to computing; for instance, some projects might belong to IT infrastructure provisioning, software provisioning and technical support to operational and administrative processes of the organization.

SCP documentation consists of the construction of specific control panel responsible for the area of computer-based technology in the corporation. The document must be approved by senior management of the organization. Defining the development order is the stage in which the priority levels of the projects are determined; those priority levels are part of the SCP to determine the chronological order in which they should be developed.

**ROLE-PLAYING GAME: AN ACTIVE LEARNING**

**FIGURE 4  
STRUCTURE OF KNOT'S APPLICATION GUIDE**



## ACTIVITY TO PROMOTE STUDENT PARTICIPATION

Role-playing game allows learning with a practical approach in an attractive context by nature to students: the game. It consists in implementing the process of formulation and implementation of the SBP and the SCP using the simulated software company as learning scenario and LARIAT software as a support tool.

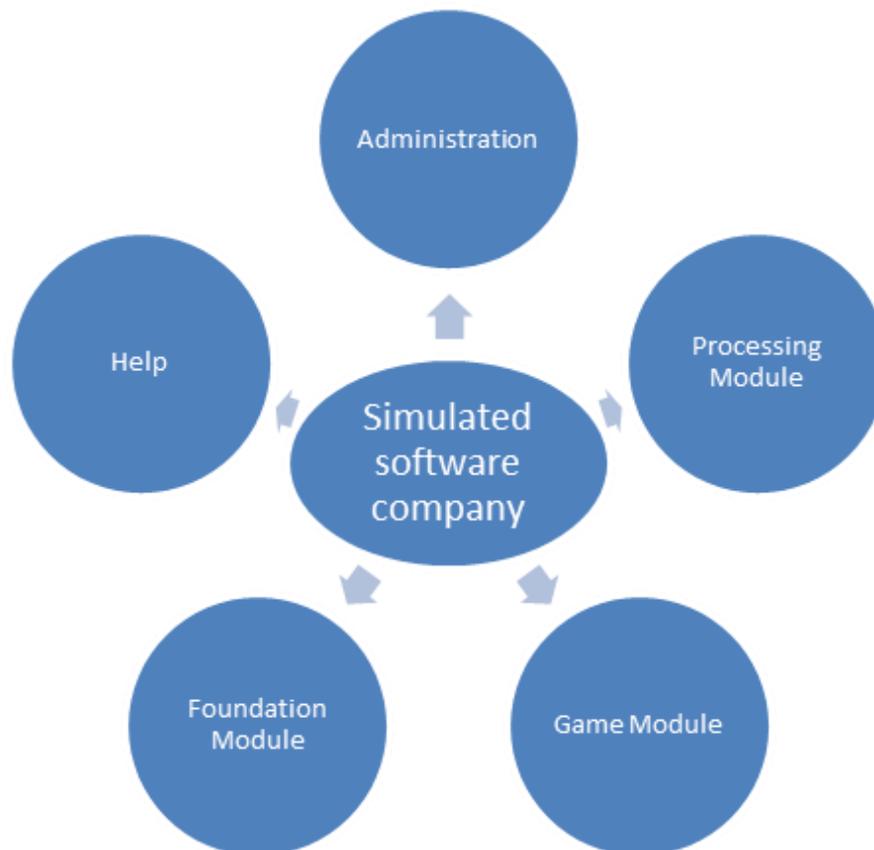
The game is presented by the professor, characterizing each of the roles and responsibilities throughout the process. Roles are defined to simulate a real organization, as individual elements that interact in group activities, such as: board meetings, activities and workshops refinement brainstorming. The strategy based on brainstorming is framed into the educative paradigm of problem-based learning. The identified roles fulfilled the functions defined in the step of defining the elements of business identification and specifically when the organizational structure of the company is established. The roles most frequently identified are: CEO tactical areas managers, heads of operating departments, coordinator of SBP and process managers for support areas. The game has features of flexibility so students can include elements that they consider relevant.

## LARIAT PROTOTYPE SOFTWARE: THE SUPPORT TOOL

LARIAT Prototype Software is a computational solution that support the proposed construction. It is relevant to make emphasis on the nature of this software; it is a support tool that implements the theoretical approach, and at this moment is functional at the level of software prototype. Figure 5 shows the modules raised to support the various components of LARIAT. It is intended to be 100% functional by the second half of 2014.

The LARIAT is a computational software solution that will support the proposed construction. Currently LARIAT is a functional prototype with limitations. It is projected the following modules: simulated software company, processing module, administration, foundation module, game module and support. The simulated software company module will provide the functionality required to manage the full amount of the elements that define the simulated organization's information. Specifically this module should allow: to create the simulated software company, defining the elements such as corporate identification, context and elements of production, administrative and marketing processes. The processing

**FIGURE 5**  
**LARIAT COMPONENTS**



module deploys the formulation and implementation of SBP and SCP. It must provide functionalities for adapting the process according to the specific characteristics of the simulated organization. The game module will provide the functionalities that allow to run the process using the simulated virtual organization as a learning scenario. This module allows getting access to students indicating the roles that they assume.

Being a software that supports a pedagogical proposal, the foundation module will provide the functionality to present the fundamentals that support KNOT, both from management theory and from pedagogical theory. Also, this module presents a detailed description of the proposal and its components. The administration module will provide the functionalities that allow the professor to track, feedback and assess the students' learning in an individual way and they work based on teamwork. Also, this module will provide the functionality to ensure data integrity, as managing users and assigning access levels depending on the role they assume. Finally, the module helps provide online tools to facilitate the operation, administration and maintenance of software.

Due to the nature of the requirements, this tool will be focused on using web technologies to enable a high level of interactivity, interoperability, performance and reliability such as HTML5, XML, SQL, Web Services, etc. Today, the prototype works with the technology above by following a MVC design pattern.

## EXPERIENCING KNOT

The Systems Engineering program at the University of Nariño, located in the city of Pasto - Colombia, includes in its curriculum the line of Software Engineering that seeks among other objectives to educate new professional with administrative competences that allow them enabling to work in companies of all types as systems managers, responsible for supporting or coordinating strategic planning processes.

This research work is motivated by the difficulty presented in the second half of 2009, during the

development of the System of Administrative and Information Management course which is offered in the fifth semester of the studies in which the subject is strategic planning. This time, a local software companies is convened as practice scenarios having a negative response, due to the main topic of such course is treated strictly in a theoretical way, promoting into students a negative perception of the subject.

During the second half of 2010, it was incorporated into the pedagogical practice the concept of simulated software company, this feature allowed the development of a more practical approach to the subject. From the second half of 2011, the set of contents related to SBP and SCP was transferred to the applied software engineering course which is offered during the ninth semester. Today there is already an operational KNOT proposal. In addition to the simulated organization, the first version of the process of formulation and implementation of strategic planning is incorporated. The results are reflected in the 12 final reports about simulated software corporations which are successfully applied to the proposal.

In the second half of 2012, KNOT evolves into a comprehensive proposal which includes: the simulated software company with more precise terms, the process of formulating and implementing more mature and documented and a role-playing game. Nowadays, students in integrated teams have 14 final reports of SBP and SCP applied to simulated organizations.

In the second half of 2013, KNOT was fully documented, and the simulated software companies are consolidated organizations as virtual learning scenarios, the formulation and implementation of SBP and SCP, to guide the implementation and role-playing game. In this context, LARIAT software was implemented as a prototype in order to supports the proposal. This time, 17 students present final reports of SBP and SCP applied to simulated organizations. In consequence of this, three undergraduate projects have started as a partial fulfillment to obtain the grade of Systems Engineers. Table 1 shows the results of the academic periods in which SBP and SCP were tried.

**TABLE 1**  
**RESULTS OF DEPLOYING KNOT AT UNIVERSITY OF NARIÑO**

Period	Students			Reports	Reports of successful KNOT application
	Attending	Passed	Failed		
B-2009	40	28	12	0	0
B-2010	42	36	6	18	16
B-2011	45	43	2	15	14
B-2012	32	32	0	10	10
B-2013	38	38	0	12	12

## FUTURE WORK

Today it has started the development of a software tool to support each of the components of the proposal. It is expected that in a work period about one year, the team has the first version of the software (100% functional) that can be implemented for evaluation in local businesses and other universities as well. Simulated Software Company is a very powerful component in the proposal, therefore it is recommended to consider those components can be used together with the role-playing game in the learning process of other issues within the business. We propose to study new modifications to the model so that it can be applied to companies of any kind.

## CONCLUSIONS

KNOT is a pedagogical proposal with a practical and participatory approach that facilitates learning of strategic business planning and strategic computing planning for software companies.

The simulated software company provides an adequate scenario to build with real parameters great experiences to students in order to know what happens in real contexts about the formulation and implementation of strategic thinking in a company.

The process of formulation and implementation of SCP and SBP used as a guide for implementation, is the right mechanism to guide students in applying KNOT, setting the inputs, outputs, and processes responsible for each step.

Role-playing game allows learning the formulation and implementation of SBP and SCP with a practical approach that ensures the active participation of all students in a context by nature attractive to students: the game.

The construction of software LARIAT, might improve the follow-up, monitoring, feedback and evaluation of the learning process.

The experience in implementing software engineering courses at the University of Nariño, has allowed validating the effectiveness of learning processes by using KNOT. This can be evidenced in the results obtained in each of the academic years in which the proposal was applied.

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