DEVELOPMENT OF A MODEL FRAMEWORK FOR CDIO IMPLEMENTATION IN VIETNAM

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ABSTRACT

As Vietnam is integrating into the global economy, it faces a grand challenge of transforming a very young population into a skilled labor force. This transformation requires the acceleration of reform in the entire education system in general, and in higher education in particular. As one of the flagship universities in Vietnam, the Vietnam National University-Ho Chi Minh City (VNU-HCM) System has spearheaded many initiatives aiming to improve the quality of education in Vietnam in order to prepare next-generation graduates who meet the needs of society. A key effort in these indicatives is the adoption of CDIO principles to build a model framework to help accelerate national efforts in curriculum reform through widespread implementation of CDIO in Vietnam. In this paper, we present the development of this model framework, which includes: a) the framework's goals of developing model university departments within VNU-HCM System that adapt CDIO principles to systematically reform their curriculum, and of using this pilot implementation to develop generalizable solutions that can be exported and replicated at other university departments within VNU-HCM System and at other universities throughout Vietnam; b) the framework's main components for achieving these goals; and c)strategies to manage the change process and to promote cultural and organizational changes. The results that we have obtained from the initial implementation suggest that the model framework has the potential for accelerating the efforts, reducing cost, and increasing the likelihood of success. To build on this, we are inviting national and international collaboration to work with us in these efforts toward the goal of improving higher education.

KEYWORDS

Vietnam CDIO, Implementation Model Framework, VNU-HCM

I. INTRODUCTION

In the last two decades, the economic reform in the Vietnam has seen a movement toward market liberalization, and in the last few years, a gradual transition to a knowledge-based economy that is galvanized by the country's impressive growth in GDP (gross domestic product) and the increased integration into the global economy through the 2007 ascension into the World Trade Organization [1]. This transition has placed greater demand on education as a critical driving force for growth and elevated the need of having a high quality education system as one of the highest priorities of the country. In higher education, although significant progress has continuously been made in the past two decades in upgrading and modernizing the system, recent higher education conferences organized in Vietnam and a number of observation studies on the quality of higher education conducted by the Vietnam Ministry of Education and Training (MOET), the Vietnam Education Foundation [2], the Vietnam-Netherlands Higher Education Project [3], the Intel Corporation [4], and benchmarking studies [2,5] have concluded that the changes in the education system have not kept up with the need of society and the demand for global integration, and that the state of higher education is generally in a weak condition. These conclusions are widely recognized in Vietnam and have been an impetus for many ongoing efforts focusing on improving the higher education system.

At the national level, the Government Resolution No. 14/2005/NQ-CP on the Fundamental and Comprehensive Reform of Higher Education in Vietnam 2006-2020 seeks to accelerate the education reform efforts with a general goal that by 2020 Vietnam has an advanced higher education system that meets international standards. This goal entails completing the establishment of a national network of higher education institutions and developing new curricula and quality assurance and accreditation processes so that some high education institutions will meet international standards [6]. Under this goal and other related efforts, MOET has introduced a number of initiatives aiming to meet the increased demand for education. Some of the key ongoing initiatives include: human resource training programs such as the 20,000-PhD program, which aims to enroll 20,000 students to obtain PhD degrees at Vietnamese and international universities and return to Vietnam to hold faculty or leadership positions [7]; the Advanced Program, which pilots the importation and implementation of U.S.-based curricula at strategic universities in Vietnam with the goal of having at least 30 advanced undergraduate programs by 2015 [8]; and the establishment of new-model universities, such as the MOET university project [9], which aims to educate students in critical disciplines and build universities that conduct world-class research that addresses needs related to public welfare.

The most recent and important changes are MOET's mandates that all universities move to the credit-based system by 2010 and that, for the very first time, all university department programs develop and publicly declare their learning outcomes. While these changes have served as a catalyst to facilitate the transition efforts, it remains a challenge for universities to develop: 1) credit-based curricula which ensure that students have opportunities to acquire the needed knowledge, skills and attitudes; 2) teaching and learning methodologies which are effective in helping students acquire deep understanding of necessary information and skills; 3) experiential learning environments which allow students to develop the hands-on experience; and 4) assessment methods which continuously provide the necessary feedback to determine the quality and improve the learning process. There are clearly many feasible approaches to addressing these interrelated issues, which collectively form a systems problem that requires a solution that ranges from improving teaching, learning, courses, curriculum, and instructor competence; to implementing continuous assessment of student learning outcomes and institutional effectiveness. However, it is a well known consensus that a key aspect to the systems solution is the development of a methodology or a model framework to systematically

address these issues, and more importantly, to have broad impact in accelerating nation's efforts in reforming higher education.

As a flagship and the largest university system in Vietnam, the Vietnam National University-Ho Chi Minh City (VNU-HCM) System is proposing a solution that involves using an innovative education initiative called Conceive-Design-Implement-Operate (CDIO) Initiative [10] as the basis for developing this model framework. In conceiving this solution, two main strengths are leveraged: 1) collaboration of a consortium of university departments within VNU-HCM System to accelerate reform efforts, reduce cost for transitioning to CDIO-based curriculum, and increase likelihood of success. These benefits would be hard to achieve by an individual university; and 2) the CDIO's systematic and comprehensive approach for curriculum reform. With regard the first strength, VNU-HCM System -- a center of excellence in education and research in Vietnam with more than 50,000 student enrollments and comprised of five member universities, two affiliated departments, one research institute, one high school and several other training centers and services – has been able to draw on the strength of its system by engaging its member universities to collaborate and simultaneously spearhead many initiatives together.

With regard to the second strength, the CDIO Initiative – a new vision for engineering education which has been adopted and implemented worldwide by over fifty universities to reform engineering and non-engineering curricula -- offers an education stressing engineering fundamentals, set in the context of the Conceiving - Designing - Implementing - Operating process. The crux of CDIO is its Syllabus, a statement of undergraduate engineering education goals, and a set of 12 Standards designed to help achieve the goals. The Standards address program philosophy, curriculum development, design-build experiences and workspaces, new methods of teaching and learning, faculty development, and assessment and evaluation. As designed, the Syllabus provides the answer to the question of what skills, knowledge, and attitudes (SKA) should engineering graduates should possess, while the 12 Standards provide the answer to the question of how we can do better to ensure that our graduates achieve these SKA. Providing answers to the "what" and "how" questions in a systematic and unprescriptive way makes it viable for department programs in Vietnam to adopt and adapt CDIO according to their needs and the unique conditions in Vietnam.

In adopting CDIO principles and leveraging the strength of VNU-HCM's system of universities, we have developed: 1) a model framework for curriculum reform that has the potential to be generalizable to other institutions in Vietnam; and 2) a seven-year plan to nucleate implementation of the framework at a few strategic departments, and then accelerate and propagate its implementation throughout all of our universities as well as peer institutions. In pursuing these goals, we will continuously evaluate and refine the framework's effectiveness in preparing students to meet the needs of society. In the remaining of the paper, we will first present the CDIO-based model framework's goals, its main components, and strategies for promoting organizational and cultural changes. Next we will discuss the initial implementation of the framework in preparing the necessary conditions to implement CDIO at our strategic university departments and to engage MOET in the process; in developing seven-year projects that begin with the CDIO pilot implementation at two different VNU-HCM's universities; and in broadly disseminating implementation materials and results. Lastly, we would like to conclude and invite other national and international organizations and educators to collaborate and work with us toward the common goal of improving higher education.

II. A MODEL FRAMEWORK FOR WIDESPREAD CDIO IMPLEMENTATION

The model framework for widespread implementation of CDIO in Vietnam that we have developed seeks to achieve the following goals:

- Adapt CDIO principles to systematically reform the curriculum of our strategic university departments and to provide students with the skills, knowledge, and attitudes desired by relevant stakeholders;
- Use the pilot implementation of CDIO at our strategic university departments as a means to develop generalizable solutions that can be exported and replicated at universities within VNU-HCM System and at other universities throughout Vietnam; and to develop the strategic university departments into model CDIO-based university departments;
- Nucleate the pilot implementation at our model CDIO-based university departments to widespread implementation at other universities in Vietnam, and, thereby, have broad impact in contributing to accelerating the nation's efforts in reforming higher education.

In order to achieve these goals, we designed the model framework to have the following five components:

1. *Alliances at the ministry, university, and department levels with involvement of other relevant stakeholders, including industry and alumni:*

To have broad impact in accelerating the reform efforts, we have formed alliances at many levels. At the national level, since 2009 we have been engaging MOET in our CDIO implementation and aligning our activities under the leadership of MOET and VNU-HCM. As the agency that regulates and approves all department curricula in Vietnam, MOET has endorsed CDIO as a viable methodology for curriculum reform and encouraged VNU-HCM to take the leadership role in developing generalizable solutions that can be used by universities throughout Vietnam. More importantly, MOET will partner with VNU-HCM to ensure that the new curriculum that will be generated from this effort will be approved for implementation because it is anticipated that the CDIO-based curriculum will most likely differ from the state mandated curriculum regulated by MOET. This is due to the fact that the state mandated curriculum takes a "bottom-up" curriculum design approach which requires university departments to build curriculum around a predefined set of courses with little flexibility, whereas the CDIO builds the curriculum with a "top-down" approach that involves using stakeholders' inputs as requirements to drive the design. Thus it is not inconceivable that the state mandate curriculum and the credit-based curriculum developed with CDIO will have to be harmonized many ways to meet MOET's requirements.

The next critical alliance that we have assembled in 2009 is a consortium of strategic university departments within VNU-HCM System that have bought-in to the CDIO philosophy and committed to its implementation. As of now the consortium consists of the Department of Mechanical Engineering of the University of Technology and the Department of Information Technology of the University of Natural Sciences. These strategic university departments take on the dual roles of using CDIO to improve their curriculum and serving as model university departments that will help nucleate the widespread implementation of CDIO within VNU-HCM System and throughout Vietnam. With regard to the first role, the advantages of having a consortium of departments within VNU-HCM simultaneously undertake the reform efforts have been parallel development and sharing of resources. Working as a team since 2009, the university departments in the consortium have identified solutions to common problems, experimented with several different approaches at the same time, and shared results using a common evaluation plan. It is our intention that every year we have several new university departments within VNU-HCM System join this consortium and use the results from these first strategic departments to begin CDIO implementation. Collectively this approach of sharing experiences and assisting each other will help

accelerate CDIO implementation within VNU-HCM System, significantly reduce the cost of transitioning to and implementing new curriculum, and, overall, increase our chance of success.

With regard to the second role, the solutions and approaches that model university departments will develop are most generalizable and effective when they are refined and improved with input from other peer departments. To facilitate this, we have established a collaborative with a number of peer university departments inside and outside VNU-HCM System that are deeply concerned with improving their curriculum, and they have committed to regularly reviewing the progress of the initial implementation. At formal meetings and conference held yearly, this collaborative of peer universities will meet with the strategic university departments to critique and refine our proposed framework, identify best practices that can be adapted and implemented in their institutional contexts, and begin to integrate CDIO elements into their curricula. Two other key groups that we will engage in these efforts are industry and alumni partners. While the involvement of industry and alumni in curriculum reform is a norm in developed countries, this involvement has traditionally not been existent in Vietnam. Thus having these two groups engage in and contribute to the reform process at our strategic university departments will be a breakthrough and new approach, and will require our special attention in managing and developing these relationships.

2. The adaptation of CDIO Syllabus and implementation of CDIO Standards

Our strategic university departments have begun adapting the CDIO Syllabus to derive learning outcomes that are contemporary and reflective of the skills, knowledge, and attitudes needed by industry. Specifically we are customizing the CDIO Syllabus and conducting surveys, focused group discussions, document research, workshops, and peer review sessions to understand the needs of industry partners and how well our programs are meeting these needs. This process has helped modify at the detailed level of the Syllabus, but it has also elucidated an important problem in defining a consensus on both the current and future need of industry for specific disciplines, especially those in the high-tech sectors. This problem originates from the fact that the maturity of the industry in Vietnam and the recent investment of international investment in Vietnam are still at an early stage, thus, Vietnamese-based companies and international companies can have very different requirements in terms of the needed skills, knowledge, and attitude. We have take an approach to both balance the different views and strive to leverage the comprehensive CDIO Syllabus to derive learning outcomes that meet highest international standards while still satisfying the specialized requirements of Vietnam.

To ensure that these learning outcomes will be met, our implementation will be guided by the 12 CDIO Standards. We intend to integrate the Standards into our program evaluation process at the department levels to evaluate the extent to which a department curriculum has implemented CDIO, and more importantly, to differentiate our department programs from other programs that want to promote their own interests by calling themselves CDIO.

3. Strategies designed to manage the change process and to overcome the barriers that are faced by Vietnamese universities: CDIO experts within VNU-HCM System

The curriculum reform changes take place in the implementation process impact most, if not all, faculty members and resources at both VNU-HCM System and university and department levels, it is important that key factors that enable the change process are in place. We have developed the change management strategies based on the CDIO 12 key success factors that promote cultural and organizational changes, which in our view, are the most difficult problems to deal with. With respect to the first phase of change (getting off to the right start): 1) The need for change is understood by most of our faculty members but at

the administrator and managerial levels this is only understood by most forward-thinking members. We believe that this will improve as we engage more external stakeholders and their input in the change process; 2) The commitment of leadership from the top has been established and vital but we seek to have a more consistent and comprehensive leadership view as we further develop this model framework; 3) The creation of this framework has served as a mean to communicate our vision to VNU-HCM System and to structure our work plan; 4) We have formulated policy support and committed budget and organized activities and cultivate internal and external CDIO experts at university and system levels to assist the strategic university departments in their pilot implementation; 5) We have generated initial successes in having our strategic university departments understand the need for change and wrote comprehensive seven-year proposals for CDIO implementation. With respect to the second phase of change (building momentum in core change activities): 6) We are still facing difficulties in moving all of our faculty members off traditional assumptions. Our strategies to overcome these difficulties are to appeal to the professionalism of our faculty members to treat the curriculum reform problem as a technical design problem, and to engage regional and international CDIO partners through collaboration and conferences to show and train our faculty members and administrators as to what and how other member CDIO universities have accomplished their reform; 7) While traditionally students are not included in the change process, but we are making initial steps in engaging them as agents of change by conducting CDIO benchmarking surveys with students and discussions with their participation at strategic university departments. We intent to give students a larger role in our future activities; 8) While the involvement and ownership of the change process have been established at the strategic university level, propagating this to the department level has not been as well defined. A mechanism that VNU-HCM will enforce to promote involvement and ownership is through assigning specific roles and responsibilities for the funding that VNU-HCM transfer to the universities; 9) At the VNU-HCM level, we have made funding available to the faculty members at the participating strategic universities departments and committed budgetary support for the reform efforts in the next seven years. With respect to the third phase of change (institutionalizing change), we have started to develop funding mechanisms and policies to ensure that the participating strategic university departments: 10) recognize and incentivize the faculty members who make contributions to the reform efforts; 11) develop expectations and standards to emphasize life-long learning of instructors and to enhance their competence in personal and interpersonal and teaching skills; and 12) institutionalize the CDIO-based learning outcomes and objectives and expected norm of student involvement in learning by formally stating the outcomes at department, module and course levels and consistently setting required patterns of learning behavior (e.g., participating in active and experiential learning activities) throughout the curriculum.

4. Funding and policy support dedicated to transition to CDIO and to enforce accountability

To sustain the reform and transition process at our model university departments, VNU-HCM System recognizes that adequate resource is an important criterion and has allocated funding to support activities at the VNU-HCM System, university, and department levels. At the university level, VNU-HCM allocates funding for common activities that are of important to the participating universities. At the department level, the funding is used to pay for participating faculty members time and conduct activities such as document research, survey, benchmarking studies, trainings, and workshops. To ensure accountability, we have required participating departments to propose their activities (i.e., specific goals to be achieved and a description of how those achievements will be assessed) and justify their budgets. We also conduct yearly review to evaluate the progress and achievements of the departments.

5. *Broad dissemination of implementation materials and results within VNU-HCM System and with other universities in Vietnam*

To help accelerate the nation's curriculum effort and facilitate widespread implementation of CDIO, we have been broadly disseminating the implementation materials and results. We have translated the CDIO book into Vietnamese and gave it for free to universities attending the workshops that MOET organized throughout the country to promote CDIO in January 2010. We host a CDIO website that makes available in Vietnamese the CDIO Syllabus, Standards, lessons learned and solutions to common implementation problems, and, in the near future, the CDIO Implementation Kits. We are also planning to adopt the open courseware model to make all of our curricular materials available. Beyond the materials, we have committed resources to "train the trainers" at several levels. At the VNU-HCM System level, we will cultivate a group of CDIO experts who will train the faculty members at member universities. These faculty members will in turn teach CDIO workshops to other faculty members in their departments. We will also organize yearly national or international conferences to share our implementation results and to teach CDIO workshops to participants.

III. INITIAL IMPLEMENTATION OF THE MODEL FRAMEWORK

We have committed substantial resources and made important strides in our initial implementation of the model framework. We have invited a CDIO expert to serve as our advisor and to teach workshops to high level managers in 2008, and to faculty members in 2009. These workshops helped establish the buy-in and support for the project at the levels of the universities within VNU-HCM system. In 2009, we bought the copyright of the CDIO book [11] and worked with our CDIO advisor and experts in the field of higher education to translate the book into Vietnamese. The book was published in January 2010. This is the first document that introduces the CDIO approach in Vietnam and serves as practical guides with complete information on the CDIO principles, philosophy, the basic approach and progress in the context of history and society. Copies of the book were distributed free to our member universities, and to MOET for dissemination during the workshops organized by MOET throughout Vietnam in January 2010 to promote the CDIO Approach for curriculum development. We participated in these workshops and invited other universities to collaborate with us.

In parallel with these efforts, since 2009, we have begun the first phase implementation of the model framework with the pilot implementation at the Department of Mechanical Engineering of the University of Technology and the Department of Information Technology of the University of Natural Sciences [12]. These two departments submitted to VNU-HCM proposals for funding and implementation of CDIO, and we provided funding for starting the implementation this year with a focus on developing learning outcomes and the overall curriculum. The Department of Information Technology will implement CDIO approach for the 4 year Bachelor of Science of Information Technology. All the regular fulltime first-year student cohorts from 2010 to 2012 will be involved in the project. The estimated number of students is 1700. The pilot implementation will take seven years, from 2010 to 2017, and divide into 3 phases: the preparation phase from January 2010 to September 2010; the first implementation phase from September 2010 to September 2013; and the second implementation phase from September 2013 to December 2017. Similar the Department of Mechanical Engineering will pursue 7-year CDIO Project for the Manufacturing Engineering Program. The project aims to improve student competence so that they become capable in the practice of engineering, to meet CDIO standards, to be able to work for international-level companies, and to improve the capacity and awareness of the CDIO

training program to managers, staff and faculty of the Faculty of Mechanical Engineering. The project is divided into 3 phases. In the first phase (2010-2011), the focus is on the program development and capacity building. The CDIO syllabus will be developed and the faculty will be trained to enhance their teaching skills and CDIO skills. In the second phase (2012-2015), the renewal courses will be provided and the new appropriate assessment methods for student learning will be carried out. In the last phase (2016-2017), program evaluation and assessment activities will take place.

An important resource that we are developing is *CDIO website and forums at www.vnuhcm.edu.vn.* This website is used to support CDIO activities at VNU-HCM and disseminate the materials developed by the implementation of our model framework and the CDIO Implementation Kits that we are translating into Vietnamese this year. Because CDIO has been implemented at two departments at two different universities within the VNU-HCM system, the CDIO website will help to manage data and information, to share materials and resources. Through the website forums, our members can discuss and share and coordinate activities to reduce cost. This website is an open and accessible channel for VNU-HCM to promote CDIO activities with collaborators all over the world and to enable us to learn and share ideas, products and achievements and get feedback on our work.

To ensure adequate resources, we are now in process of submitting proposals to the Ministry of Finance, Ministry of Education and Training, and Ministry of Planning and Investment to fund our project. We also have plans to establish collaborative relationships with stakeholders including industry, professional associations, businesses, and alumni and to encourage them to participate and contribute to the project. Until now, several universities outside VNU-HCM and companies have expressed interests working with us in implementing this project. We also utilize the support of our partners worldwide, especially members of the CDIO Initiative.

IV. CONCLUSION AND INVITATION FOR COLLABORATION

To address the need in accelerating the curriculum reform efforts to meet the demand for Vietnam's integration into the global economy, we have developed a CDIO-based model framework for widespread implementation of CDIO. The implementation of the framework and its achievements in piloting CDIO at two university departments within VNU-HCM, in engaging MOET to promote CDIO in Vietnam, and in disseminating implementation materials, notably the Vietnamese- translate CDIO book, suggest that the model framework has potential to facilitate parallel development and sharing of resources and ideas, and most importantly, impact the nation's effort to accelerate curriculum reform through widespread implementation of CDIO. Given that this is a model framework, we seek to continuously refine the model as we make more progress in implementing CDIO. In pursuing this goal, we believe that many countries are facing similar problems, and that we can mutually learn from the important resources and approaches that various institutions are developing. Thus, we would like to invite you to collaborate with us in our pursuit of perfecting a model framework for widespread implementation of CDIO in Vietnam and worldwide.

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