

Approaching CDIO to Innovate the Training Program for Seafarers to Meet the Requirements of the Industrial Revolution 4.0

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Abstract— Vietnam is located on the normal arterial maritime route between the Indian Ocean and the Pacific Ocean, between Europe, the Middle East, China and Japan with regional countries. In the context of the industrial revolution 4.0 and the deeper integration of Vietnam's economy into the global economy, Vietnam's maritime industry is increasingly developing and deepening international integration. The rapid development of the domestic fleet and the labour export service of seafarers are setting out for our maritime schools the opportunity to train crew members. Improvement of training program for seafarers are considered an urgent issue, which is also a prerequisite for contributing to the development of the maritime industry actively. However, the initial integration and practice in the past few years show that the officers and crew have increased in sufficient quantity to meet the market demand but are showing many professional and operational defects, practical skills, foreign languages when working on modern ships or multinational vessels. The limitation of crew members is due to many factors, one of the basic factors is the quality of crew training, and the defects that do not meet the practical needs, especially training programs at training institutions are outdated. The paper analyses the status of the quantity and quality of Vietnamese seafarers from 2010 to 2018, propose measures to improve the quality of maritime human resources, with a focus on building and developing crew training programs by CDIO approach to meet the requirements of businesses and society for future crews.

Keywords— industrial revolution 4.0; CDIO approach; a training program for seafarers.

I. INTRODUCTION

An economy that wants to develop quickly and sustainably must be based on three primary axes: applying science and technology, developing infrastructure and developing human resources, in which human resources hold an important role. The level of human resource development is a key measure of the development of each country. Therefore, this issue is very concerned and respected by countries around the world. Inheriting and promoting the tradition of the father in the use of talents, considering "talent is the national spirit," in each development period, our Party and State always affirm the viewpoint of factors people are the center of every development. Currently, in conditions of accelerating industrialization, modernization, and international integration, especially when Vietnam is in the period of industrial revolution 4.0, human resources issues, especially is a maritime human resource which is considered a breakthrough, developing maritime human resources to become a sustainable development foundation and increasing the national competitive advantage [1].

Vietnam is a country with coastline along the length of the country; the continental shelf is nearly 1 million km²,

three times the land area, has a prodigious value and potential. Moreover, with the location near the international maritime route, convenient for maritime services and exchanges with the world market, the shipping industry is considered as one of the key economic sectors of the country. The Fourth Conference of the Xth Party Central Committee set out the "Vietnam Sea Strategy to 2020", including the strategy of developing sea transport, seaports, maritime services, and marine human resources. This is a decisive direction for exploiting resources from the sea, contributing to the economic development of the country [2].

Maritime Vietnam is taking major steps, opening up international integration, approaching and immersing in the flow of technology 4.0 to deserve a national key economic sector. With the advantage of being a coastal country, located on the most vibrant international shipping route of the region and the world, Vietnam has very favorable conditions for developing marine economy, contributing to socio-economic development sustainably. Capturing this advantage, over the past years, the Party and the Government have always paid attention to marine economic development and maritime development. In the context of the world implementing the 4.0 Industrial Revolution, attention should be paid from the marine economy based

mainly on investment capital, exploitation of natural resources, causing environmental pollution to the economy based on knowledge, science, and technology foundation, effectively promote the potential and advantages of Vietnam sea[3]. To attach importance to training human resources, developing science and technology, taking advanced science and technology and high-quality human resources to make breakthroughs for marine economic development.



Fig.1. Development trend of the industrial revolution 4.0 and shipping 4.0[4]

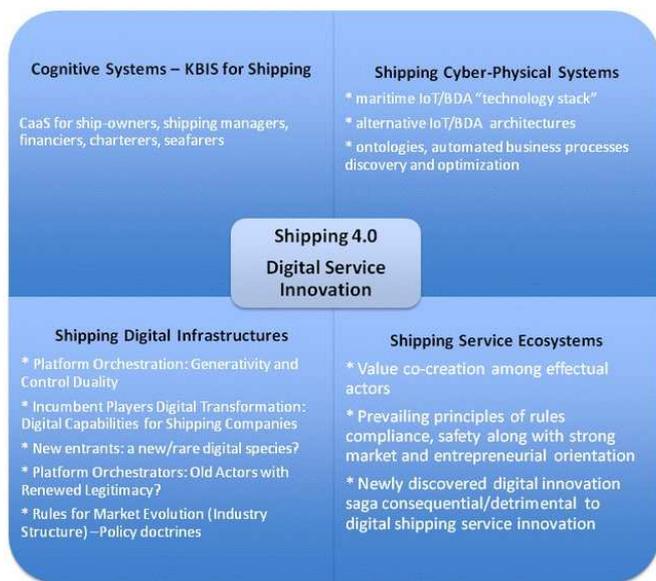


Fig.2. The effects of shipping 4.0 on the maritime industry [5]

In fact, in recent years, Vietnam Maritime Administration has implemented solutions to the content "Promote education, training, and development of marine human resources" according to Resolution No.36-NQ/TW dated October 22, 2018, of the 8th Conference of the Party Central Committee XII. The strategies of sustainable development of Vietnam's marine economy to 2030 with a vision to 2045 are (1) studying mechanisms to support and improve the quality of training and development of a network of training institutions for training sea human resources with advanced

levels in the region; (2) effectively implementing vocational training, meeting the labor requirements of the marine economy and the job conversion of the people; (3) coordinate with the Vietnam Maritime University building training program, trained seafarers working on board at the poles [4]. Also, the Vietnam Maritime Administration has completed the European Maritime Safety Administration (EMSA) report on the compliance of Vietnam's training, training, and certification with the STCW Convention [7]; prepare content to work with the International Maritime Organization (IMO) on the assessment of the implementation of STCW Convention 78/2010[8].

The contingent of officers and crew of Vietnam has been gradually taking over, affirming its position in the labor market of the region and the world. Vietnam Maritime Officers have assumed the highest positions (captains, chiefs) on vessels considered the world's largest and trusted and appreciated by shipowners[1]. However, the reality also shows that the contingent of crew members has increased in quantity, but also revealed many shortcomings, limitations, poor practice, and inexperience. Health is not good. The spirit of sticking to the job is not high. Many workers are not yet professional. The public is weak in foreign languages. The ability to use informatics is still slow. Workers are weak on teamwork skills. Attitudes sometimes lack enthusiasm. The industry is not in industrial style, and workers are unaware of the concept of "going to work," not familiar with the concept of working as an employee and international integration. Facing these situations, the training of high-quality maritime industry is always considered an important foundation [9].

Therefore, the maritime industry in general and the training facilities of crew and officers in particular in the coming time need to strengthen the linkage between shipping enterprises and training institutions to develop training programs[10] jointly. Advanced creation to help learners and crews of the future can meet social needs. Before that urgent request, it is necessary to apply a modern training model from advanced education to improve the quality of training comprehensively [11]. The integration of the new training program will help to raise awareness and skills on marine pollution prevention and control such as techniques for handling and responding to oil spills [12], [13] or pollution caused by engine emission [14].

Also, seafarers will improve their ability to cope with marine situations such as piracy [15], fire and accidents [16]. CDIO is considered a modern education model that can meet the requirements of business and society. In essence, CDIO is a solution to improve the quality of training, to meet social requirements by determining learning outcomes, thereby designing training programs and plans [17]. This process is built scientifically, logically, logically and can be applied to many different training areas. CDIO is now considered as a new initiative for education, a system of methods, forms of accumulating knowledge and skills in improving the quality of higher education to meet the requirements of enterprises and society [18]. Training in 12 standards of CDIO helps crews improve perceptions of energy management and use on board, such as optimal and environmentally friendly fuel use management [19]; control of the spraying process and better fuel burn [20], [21]; take advantage of the waste heat

energy of the engine [22]; Control the spraying characteristics [23], emission and deposits formation in the combustion chamber when using biofuels [24]–[26].

CDIO provides not only learning outcomes, but also a clear guide to training and management of education. CDIO provides leadership method and management of higher education. It develops faculty with deep expertise and strong corporate integration with higher education base. Also, CDIO provides project-based learning method, framework program reform, informal communication skills, experiential learning and initiative, designing training programs, and lips school, how to check, evaluate, and internationalize higher education [27]. Therefore, it can be said, CDIO is very useful in implementing effective training programs, is one of the solutions to improve the quality of higher education. Therefore, the application of CDIO model to build training programs and train crews at training institutions in general and Vietnam Maritime University, in particular, is very practical and meaningful. It will solve the problem of improving the quality of human resources in the maritime industry to meet the requirements of the industrial revolution of 4.0 [2].

The paper analyses the current situation, characteristics of training, crew training and capacity of Vietnamese crew members today, offering solutions to improve the quality of crew training, special emphasis is placed on building training and training programs for seafarers following CDIO approach.

II. MATERIALS AND METHODS

A. *Quantity and Quality of Seafarers*

According to statistics of the Vietnam Maritime and Crew Registration Board - Vietnam Maritime Bureau as of June 2018, the number of Vietnamese seafarers is nearly 40,000; of which 20,000-25,000 seafarers are operating on approximately 1,600 marine transport vessels.

From 2000 up to now, due to the demand for large maritime personnel, maritime schools throughout the country have increased the number of significant training: Vietnam Maritime University annually recruits over 800 students for two faculties. Ho Chi Minh City University of Transport recruits from 250-300 students each year to two marine faculties. Besides, the colleges and intermediate schools training for the maritime industry only recruit about 200 students/school for two maritime faculties [1].

With the marine strategic orientation set by the Party and the Government, by 2020 Vietnam will become a strong sea nation. However, to achieve the set goal, the shipping industry is facing a great challenge of human resources, especially the crew. The demand for Vietnamese maritime personnel is huge. Based on the plan of sea transport development to 2020 and vision to 2030 approved by the Prime Minister, by 2020, Vietnam will have to reach about 42,000 high-quality officers and trainers; of which about 15,000 new trainees (7,000 additional people according to the requirements of fleet development and 8,000 people replacing existing forces). Along with that, about 6,000 officers manage and about 9,000 seafarers, technical workers will also have to be trained to create human resources to meet the needs of sustainable economic development and

contribute to protecting owners — island rights. Moreover, by 2030, about 66,000 crew members, of which officers of different types of war, 30,000 people [28].

To implement the sea comb, specifically the shipping industry, seafarers are particularly important. This team requires good professional knowledge, skills and foreign language. However, in our country today, the force of crew members lacks and weak in terms of expertise such as lack of experience, lack of industrial style, ability to practice young, poor health, limited English ability... not yet fully met practical needs.

Currently, the country has more than 45,000 trained naval officers, but only 27,500 direct ships and more than 18,000 are onshore and transferred to another industry. If this situation does not change, according to the marine economic development plan, by 2020 - 2025, Vietnam will fall into a serious shortage of seafarers.

Through the above analysis, if not discussing quality, with a fleet of thousands of ships, newly built domestic ships, imported are rising rapidly, and the demand for labor export is growing, the difficulties about hunting crew members, especially senior management titles, is not difficult to explain. It has long been alarming for the country's maritime industry. According to the Vietnam Maritime Administration, by 2018, Vietnam will have a shortage of 800 - 1,500 officers, mainly managers, not to mention the labor export demand [9].

Only when it comes to quantity, Vietnam lacks in human resources for the maritime industry to an alarming level; we have been losing at home and the international playground. Vietnam has lagged far behind its neighboring countries with the same conditions, ignoring an opportunity that a few dozen years later, with a high determination can be filled with expectations. Up to now, training institutions have continuously released some annual seafarers to provide for the domestic labor market and labor export. According to the Maritime Bureau, there are currently more than 27,000 people working on Vietnamese ships and exporting labor on foreign ships or leave. The authenticity of these numbers cannot be determined because the total number of graduates and the working age of both machines and the electric deck is much larger. There are thousands of crew members in the working age who quit their jobs or moved to work for shipping companies on the shore [29].

Seafarers with low quality are still in stock with a small number. As a result, transport companies recruited crew members for their fleets were registered by the crew, but when the interview was conducted, the rate was too low. Many seafarers are not qualified enough to return to the river-going river vessels that run inland with little salary ..., and how many strange things have arisen there.

Many foreign companies also interviewed and recruited Vietnamese crew members, but the rate of meeting the requirements was too small, the worst was the practice, the understanding of maritime law and especially English was too weak. That is one of the reasons so far only more than 2,000 Vietnamese crew members have been recruited to work on foreign fleets. Vietnamese crew members also have many valuable qualities. Vietnamese seafarers are trained in as many numbers as possible, not afraid of redundancy, as long as good practice, good foreign language; there is never

a shortage of jobs on fleets of countries around the world. Some domestic shipping companies had to recruit many foreign crew members for Vietnamese vessels from high-level captains, chief engineers to sailors from India, Myanmar. There are many warnings that one day we have to recruit Cambodian crew trained in a Chinese-trained training center, including a train. The cruel thing is that these seafarers are willing to accept low wages to accumulate time to go to sea before stepping to strong fleets in the world [30].

It is an alarm bell for our training institutions to wake up the province soon and have solutions to overcome, improve the quantity and quality of Vietnamese crew members more, soon retake this critical and strategic market share in the next few years.

B. Training capacity of maritime training and training institutions in Vietnam

1) *Number of training institutions:* Currently, the Ministry of Transport has granted a license to train crew members for training institutions located at the following schools: Vietnam Maritime University and Ho Chi Minh City University of Transport, Ho Chi Minh City, Maritime College I, Ho Chi Minh City, Hai Phong Polytechnic Vocational College, Coastal Vocational College, and Vietnam Shipping Joint Stock Company. Thus, the Central region is home to many large seaports, many national-scale industrial parks, this is also a place with great potential in providing human resources for the maritime industry, but there is no real reality at present. Any maritime training and training facility. It is clear that the network of maritime training and training facilities has not been properly distributed throughout the territory of Vietnam but only concentrated in the North and the South [6].

2) *Education program:* The content of training programs for maritime officers in Vietnam is quite basic, reaching a deep and wide level of theory. It meets the minimum requirements of STCW 95 CODE, evaluated by IMO: "complete and effective." However, it can be said that the training and training program is not very reasonable, the rate of basic theoretical lessons on the total number of specialized lessons in all systems and types of training is still high; The training time at university is relatively long (4.5 years). The connection between training institutions and enterprises uses superficial and formal labor; There is no commitment to create a motive to improve the quality of training crews [31].

3) *Competence of teachers/coaches:* The vast majority of teachers only like to teach theory (including practice also described by theory), this is a real need for innovation from every teacher. Teachers working at maritime training and training institutions are lacking in both quantity and quality, especially those with high academic, academic titles and professional researchers. Has a high level of expertise and good foreign language ability to conduct technology transfer research and international cooperation? Besides, the rate of teachers studying at the school and staying at school is very high, especially the university-level training schools. It is this phenomenon that will make the training of trails obsolete, no new airflows that change the thinking of the teachers [32]. In some maritime training and training

institutions, there is also the phenomenon that the top teachers do not focus entirely on the training and training tasks of the school, so the quality of teaching and management is low [33].

4) *Material facilities and equipment of maritime training and training institution:* Most training institutions do not have specialized standard classrooms, visual tools, teaching aids are lacking; the equipment for practice and experimentation is still inadequate and sometimes even outdated, incompetent to do experiments, practice exercises, subject-learning subjects and practice are just examples. The simulation rooms are not large enough to carry out the training for trainees according to the regulations of the International Maritime Organization; most maritime training institutions do not have an internship in their own right. Many maritime training institutions and libraries have not met the learning needs of students and students; the number of books is limited; little foreign documents.

III. RESULTS AND DISCUSSIONS

A. Strengthen training scale

In addition to 2 universities and four colleges and maritime schools in Hai Phong and Ho Chi Minh City. Currently, Ho Chi Minh City needs to develop a national vocational training network, especially in the Northern Delta, Central Coast, Southeast, and Mekong River Delta regions; attracting children to work, especially children of fishermen who have no jobs; enhance the promotion of recruitment of crew training classes according to the world model.

B. Expand training

Expand enrolment in colleges, vocational schools, in remote areas; building inter-school regimes for seafarers after going to sea for 1 to 2 years to attract students; strengthen the dissemination of training models according to the pilot project on maritime officers training approved by the Ministry of Transport. Expand training facilities to be located in coastal areas, convenient for young people in coastal areas, and take advantage of the river environment to combine vocational training and the quality of seafarers.

To attach importance to training military personnel, especially formulating appropriate training programs for demobilized military personnel. Training according to customers' requirements, Training crew members both meet the requirements of the international convention STCW, the current regulations of the country, and satisfy the requirements of domestic and foreign ship owners. Promote popular propaganda to ministries, agencies, state management agencies, associations, shipping enterprises, crew ...to understand and recognize the importance of the Convention, and be responsible for the Ministry of Transport in implementing the Convention.

Encourage all components, including private and foreign investors, to synchronously invest in facilities and equipment by the STCW Convention for training institutions. The government can offer preferential loan packages for those who participate in seagoing vocational training; exemption from military service after graduation for seafaring; study special insurance regime for seafaring

career; study and propose the Government to issue a decree on crew members; It is necessary to honor the seafarers; every year should be Vietnam Crew Day.

It is innovating the way of teaching, learning the language and assessing the English in the maritime industry to meet the reality of the profession. This is a key factor in providing seafarers working for foreign ship owners. Training of good teachers: Formulating standard regulations for teachers of specialized subjects must have at least 2 -3 years of experience in the sea, at least holding the title of Vice-Captain 3 and Machine 3 one year before becoming a professional lecturer; There is an appropriate remuneration for teachers who teach specialized subjects to attract experienced seafarers to teach, especially practical instructors. Coordination of shipping enterprises: Enhancing the coordination of shipping enterprises in the process of training crew members; There should be a regime to encourage shipping enterprises to receive interns. There are sets of standards for assessing Vietnamese crew members: Standard set of assessors for sailors/mechanics; Assessment standards for officers operating deck/machine; Benchmarks for deck/machine management officers.

C. Develop Training Programs by the CDIO Approach

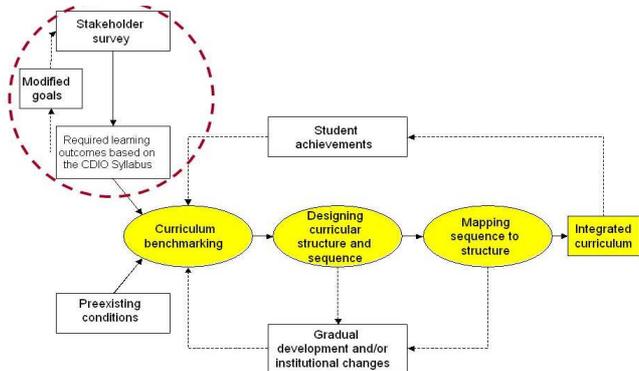


Fig. 3. The curriculum design process [3]

Over the past few years, recognizing the responsibility to the deteriorating situation of seafarers, Vietnam Maritime University and Ho Chi Minh City University of Transport has made significant changes and solutions. The curriculum has been streamlined and improved; the learning time has been reduced to 4 years. The labs and labs have been strengthened and strengthened. Especially the training program and training of students and crews have been initially built according to the CDIO approach.

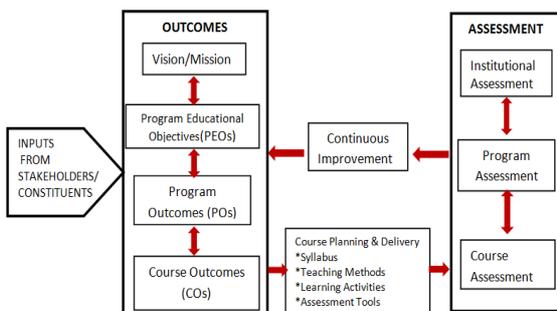


Fig. 4. Develop training programs to approach CDIO with the close relationship between outcomes and assessment [34]

Currently, Vietnam Maritime University is urgently rebuilding all training programs according to the CDIO (Conceive - Design - Implement - Operate) approach and meeting the requirements of international accreditation. The development of CDIO training programs with the full participation of related parties: Teachers, learners, employers, managers ensure practicality and ability to meet commune needs Assembly of training programs. This is an advanced, scientific approach, aimed at fully forming the capabilities and qualities of learners in addition to training knowledge and skills. In addition to defining the professional and professional output standards, the school pays special attention to the output standards of foreign languages and information technology.

Steps to build a training program according to the CDIO approach of Vietnam Maritime University:

1) *Step 1. Convert CDIO's vision to the objectives of the Training Program.* This is the first step to restructure the training program. The objective of training the industry inherent in the credit-based training program has not met the contents of level 3 learning outcomes. In the process of reforming the training program, it is necessary to reconsider to change the vision of CDIO into a new training target with the integrated training program under the CDIO method [36]. That means educating students to master the basics; train them to be leaders in building and implementing industry products/projects; and understand the importance and strategic impact of the research and development of the industry.

2) *Step 2. A match training program with a credit system with level 3 output standard.* As a starting point for the design of an integrated training program by CDIO method, the matching aims to understand the specialized structure and test the training program according to the old credit system. Through it to know how well it has met expectations of the level of desired competence in the Level 3 learning outcomes, and to make the data necessary for the design of the new training program. The matching is done by interviewing the teachers who teach the subjects in the old training program through a Survey of Teaching Activities - The ITU assessment exercise as follows: Each lecturer does this assessment for the subject that he directly teaches, provides information on the topics of knowledge and skills that I have introduced (I), taught (T) & used (U) how.

3) *Step 3. Survey to assess the relationship and coordination between subjects:* Survey of trainers on the relationship between the subjects in the old training program to establish existing professional contacts within the old curriculum. The purpose of this survey is to clarify the links between core/compulsory subjects (in the credit system) of the old curriculum. To support the coordination of subjects and initiate the development of output standards for each subject of the output standard (m), each teacher needs to establish the inputs and outputs of that subject by Black Box exercises.

4) *Step 4. Adjust the level 3 learning outcomes and the Draft Curriculum Framework by CDIO approach:* The studies from the three surveys above serve primarily for the reconstruction of the curriculum framework, but also

contribute to the adjustment of topics in the level 3 learning outcome to suit the current situation through assessments of teachers in the above exercises. After the lecturers complete the above contents, the Department of CDIO project management board synthesizes and analyses the feedback results from the survey to comprehensively review the structure of the old training program; From there, review and analyse carefully to meet the topics in the learning outcomes of all subjects of the old training program;

Based on the survey information and the above idea, the subject departments' review to show some key issues related to the topics in the level 3 learning outcome among the subjects under their charge as follows:

- Are there any topics that are not supported by any subject?
- Are there any topics that VMU's current resources cannot meet?
- Which topics need more or less attention;
- Identify topics that have been introduced many times but have not been taught in a real way by lecturers (these will be priority topics for improvement);
- The importance of each topic compared to the remaining topics ...

After implementing the above process, the departments also provided a summary of the topic of output standards in the subjects under their management and pointed out the topics in which are still weak.

Next, the CDIO Project Management Board discusses and makes related decisions on the following contents:

- Modifying or changing the content of teaching some subjects to create continuity in the level of providing knowledge and skills to students during the training process;
- Open any new subject to supplement some important knowledge and skills without any support in the old program;
- Proposing a compilation plan for the introductory course of the training industry;
- Subjects rebuild the roadmap for developing each topic of the output standard (knowledge and skills relationship) between the issues more appropriately (this will be specifically mentioned in Step 5).

Finally, the CDIO Project Management Board decides on whether to adjust or change:

- Topics of level 3 learning outcomes,
- The contents of the integrated training program.

5) *Step 5: Design the integrated training program:* After the learning outcomes and training program contents have been adjusted above, the critical aspects of the design of the new training program followed by the curriculum design (raw selection organizational rules, master plans, subject structure). The next aspects in this step are designing teaching sequences and mapping the sequence into the structure (matching the learning outcomes into subjects; integrating skills and attitudes into the subjects of the curriculum).

The structure of the training program is the arrangement of the content and corresponding learning outcomes into teaching units or subjects to support the link between the

subjects. The requirements of course structure require the integration of skills into the training program according to the CDIO approach, as required in Standard 3.

The sequence of teaching content of the training program is the order of students' learning process. If the process is properly designed, students' learning will follow a cycle in which each experience is built on previous experiences, while reinforcing those experiences. In most cases, these sequences are built on the experience of the instructors, who teach and write the curriculum of the training program. However, the course sequences in the existing training programs of the old training programs are mainly focused on knowledge blocks rather than skills and attitudes and have not been addressed consider the experience fully.

The design of the training program refers to aligning each topic of the skills needed in the courses in a sequence like a development roadmap. Sequencing using this development roadmap will facilitate the next step of the curriculum design process, which is to match skills to the training program.

The process of developing new training programs can be done before embarking on developing the Learning Outcomes (and the Detailed Outlines) for each subject in that program. However, it is possible and should follow the way of interaction between the two stages, which means both are completing the new training program and designing the learning outcome of each subject. The learning outcome (m) are gradually formed and exposed in the above studies on the surveys/correlation and coordination among items to take the level 3 learning outcomes.

In a training program using the CDIO approach, each subject of the new training program is responsible for some new learning outcomes of that program. Each lecturer in charge of the subject of the new training program must build the learning outcome for that subject: learning outcome (m).

To embark on the development of the output standard (m), the Department Heads together with the faculty in the Department should carefully study the aggregate results from the ITU Assessment Exercise, survey to assess the relationship between subjects, Black Box exercises in sections 2.1., 2.2. Moreover, 2.3., and desired level of learning outcome topics [2].

After the structure of the training program and the sequence of subjects in the training program has been established, the next step in the process of designing the new training program is the Reciprocal Sequence on the structural elements. This requires a clear plan to integrate personal skills, communication skills, and skills to create products/projects (necessary skills) into the training program.

6) *Step 6: Develop a draft third training program:* Chairman of CDIO Project Management Board of the Faculty of Drafting the 2nd training program and organize a wide workshop to get feedback from managers, scientists, experts, establishments recruiting graduates, lecturers, students, and alumni ... and completing the training mentioned above program. This step product is the 3rd training program Draft.

7) *Step 7: Evaluating and comparing training programs with level 3 learning outcomes 3rd:* Council of Science - Training evaluates and compares training programs with

level 3 outcomes 3rd, quality accreditation standards and suggestions for completing the training program by the professional positioning of training products. The Management Board of CDIO project completed the training program according to the CDIO approach.

8) *Step 8: Approving and officially issuing the Training Program under the CDIO model:* Project Management Board of CDIO Project Completes the curriculum Develop training program according to CDIO approach of the Project to submit to the Principal for approval and officially issued a training program according to the model of CDIO of higher education institutions under the formal system of VMU.

9) *Step 9: Develop level 4 learning outcomes and detailed outline of subjects:* Project management board CDIO plans to build level 4 output standards and a detailed outline of the core subjects of the industry following the CDIO approach.

IV. CONCLUSIONS

The process of international economic integration requires a higher quality of human resources and increasingly fierce competition among countries. By the requirements of the maritime industry during the integration period and the trend of the 4.0 revolution, the State needs to plan a unified strategy and plan for developing maritime human resources from the central to the ministries, branches, and establishments.

Training in maritime universities and professions shows that the situation of technical facilities and training programs of Maritime schools is still limited. Because this industry is characterized by a practice that requires a constant combination of "learning" with "onion," students need to practice on ships or simulation models and modern audio-visual devices. Therefore, the training program needs to ensure the integration of thinking skills, teamwork, and communication to ensure learners learn actively and experience. The selection of the CDIO approach to building training programs and training for crew and officers is the right direction. It not only helps improve the quality of training human resources in the maritime industry but also enhances international standards and meets the increasingly demanding requirements of shipping companies. By changing and innovating the training program, the issue of training human resources in large numbers and competitive quality will be promoted quickly, breakthrough and resolutely to solve the problem serious shortage of human resources today.

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