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Alumni's perspectives on the training program of the universities administered by the Vietnam Ministry of Transport: an EFA-based descriptive study on CDIO

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Abstract: This article reports on a study of four universities run by the Vietnam Ministry of Transport. The study uses a 40-Likert-seven-point-item questionnaire and exploratory factor analysis (EFA) to analyse 312 alumni's perceptions on the academic program. The current academic program fulfils 45.19% of alumni soft skill, work communication, and work skill needs. The six scales derived from the 12 CDIO standards that influence alumni attitudes are, from strongest to weakest: 1) teaching and learning methods; 2) design-build experiences; 3) integrated curriculum expected; 4) learning outcomes; 5) assessment and evaluation; 6) faculty teaching skills. The EFA results show a good correlation between the six components, with R values of 0.922 and R^2 of 0.851. 85.10% of the six criteria explain the stakeholders' requirements. Sig. value 0.0005, from F (6, 305) = 289.788, shows that the regression model predicts alumni perspectives. The results provide clear evidence to the academic program designers of the four universities in the study when revising the academic program to approach the CDIO philosophy.

Keywords: CDIO academic program; CDIO standards; alumni' perspectives; change management; EFA-based descriptive.

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1 Introduction

The current higher education system these days has been inevitably undergoing changes caused by the emergence of the demands of our digital society. Students nowadays have better access to reliable and attractive information as they are well equipped with electronic gadgets together with good internet connection and have less interest in learning through the conventional method due to its unattractiveness and time-consuming process (Muhammad et al., 2018) Since pupils are not able to comprehend the lecture, the occurrence is counterproductive to the learning process (Muhammad et al., 2018). The skills of effective communication and technical report writing are crucial for engineers, but Muhammad et al. (2018) note that students often lack these abilities and struggle to redeliver and apply the core knowledge in certain situations. To curb this problem, a new teaching and learning philosophy should be introduced to meet the increasingly relevant requirements due to the rapid development of Industry 4.0. The CDIO philosophy of teaching and learning came into existence in such requirements (Bates, 2001; Oppenheimer, 2003; Chester et al., 2011; Belland et al., 2013; Means et al., 2010; Oliver and Trigwell, 2005; Salmon, 2005; Sharpe and Roberts, 2006). Coming into existence in October 2000 when four universities, comprised of the Royal Institute of Technology, Linköping University, the Chalmers University of Technology of Sweden, and the Massachusetts Institute of Technology of the US, under the sponsorship of the Knut and

Alice Wallenberg Foundation, launched a new ungraduated engineering education to improve the quality of the academic program, the CDIO philosophy quickly has been accepted worldwide when the teaching philosophy provides students with an education stressing engineering education fundamentals set in the context of conceiving – designing – implementing – operating real-world systems and products (Berggren et al., 2003; Crawley, 2003). Crawley et al. (2007) note that the CDIO teaching and learning philosophy has changed the moving-down trend of students' creative thinking since the pre-1950s to have a trade-off curve since the 2000s with the appearance of the CDIO philosophy (Callueng and Jocson, 2021; Rajest and Suresh, 2018a).

One of the important requirements of the CDIO philosophy is the participation of key stakeholders, including engineering faculty, students, industry representatives, university review committees, alumni, and senior academicians (Crawley et al., 2007). When creating program learning outcomes, the opinions of alumni are the most essential source of evidence since they are the only stakeholders who can know both the levels of competence attained at the university and the levels of competence they have needed as graduates (Armstrong and Niewoehner, 2008). Malmqvist et al. (2014), who originated the concept, said that feedback from program alums, outside review committees, and program board members is all beneficial. Bankel et al. (2005) also surveyed alumni's point-of-view towards the academic program to benchmark the engineering curricula with the CDIO syllabus (Chumsukon, 2020; Havryliuk, 2020; Jayakumar et al., 2022).

Since 2010, Vietnam has imported the CDIO philosophy into higher education (http://www.vnuhcm.edu.vn). The benefits that the new teaching and learning method bring to the students and the institutions have been continuously proved (Guiamalon, 2021; Rajest and Suresh, 2018b). Upon the trend, the four universities administered by the Vietnam Ministry of Transport have decided to approach the CDIO philosophy. The study in this article is conducted as a part of the preparatory steps for implementing the CDIO approach in teaching and learning, concretely the academic program, at the four universities in the study (Guiamalon and Hariraya, 2021).

2 Objectives and research questions

This article aims to:

- Investigate the perspectives towards the academic program of the alumni graduating from the four universities administered by the Vietnam Ministry of Transport.
- Explore the effects of the six scales alphabetically
  1 assessment and evaluation
  2 design-build experiences
  3 expected learning outcomes
  4 integrated curriculum
  5 faculty teaching skills
  6 teaching and learning methods put on the alumni's perspectives.

From the two above objectives, two research questions were formulated:

Research question 1 How do the alumni from the universities in the study think of the corresponding relation between the academic program these alumni learned and the working requirements in terms of workers' professional ability, soft skills, and characteristics?

Research question 2 How do the six scales of,

1 assessment and evaluation
2 design-build experiences
3 expected learning outcomes
4 integrated curriculum
5 methods of teaching and learning
6 faculty teaching skills affect the corresponding relations between the academic program and the working requirements?

3 Literature review

3.1 The CDIO philosophy

To ensure that students receive an education in which engineering fundamentals are emphasised within the context of conceiving, designing, implementing, and operating (abbreviated as CDIO), an academic program that adheres to the CDIO philosophy will cover the four topics listed below (Berggren et al., 2003; Lynch et al., 2007; Chen et al., 2020).

- It is important that today's youth have many opportunities to acquire the understanding, competence, and character traits necessary to conceptualise and design sophisticated systems and products.
- To improve levels of teaching and learning necessary for a deep understanding of technical information and skills.
- To provide students' experimental learning environments with laboratories and workshops.
- To determine the quality and improve learning by applying effective assessment methods.

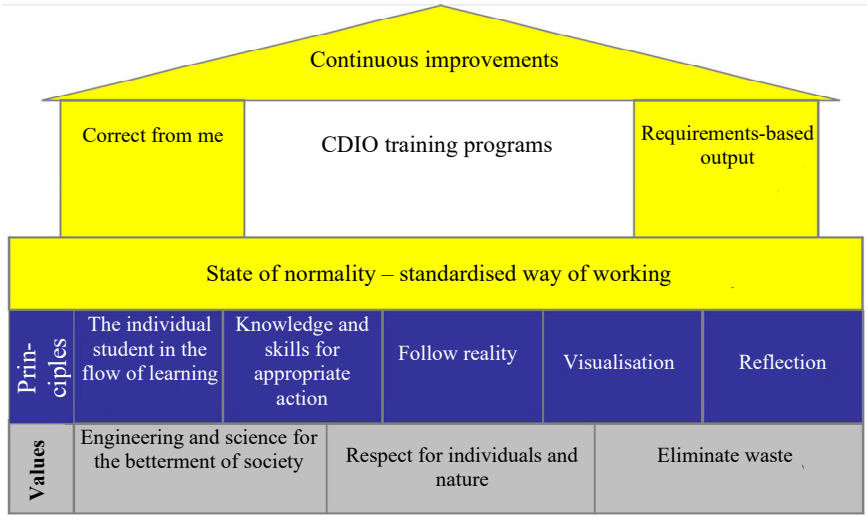
By applying the four themes, an academic program approaching CDIO philosophy aims to educate students.

- To master a deep working knowledge of technical fundamentals.
- To lead in the creation and operation of new products and systems.
- To understand the importance and strategic value of their future research work.

The CDIO initiative was developed with input from academics, industry, engineers, and students and in such a manner that it is universally adaptable to all engineering programs and all academic institutions (Lynch et al., 2007). The most important foundation for an academic program approaching the CDIO philosophy is that the graduates "understand

how to conceive – design – implement – operate complex value-added engineering systems in a modern team-based environment and are mature and thoughtful individuals" [Crawley et al., (2007), p.13]. As a result, an academic program approaching the CDIO philosophy can create engineers who meet the demand of the work in the current situation (Crawley et al., 2007; Boden, 2007; Östlund et al., 2007). Further, Östlund et al. (2007) considered CDIO academic programs as being 'managed by means', the development effort is guided not by specific, predetermined goals, but rather by shared values and principles. Contrast this 'management by means' approach with the conventional 'management by outcomes' approach used in most modern academic programs. As per the following concept of an educational home (Östlund et al., 2007), academic programs that adhere to the CDIO philosophy strive to provide a forum for participants to discuss the organisation's current state of affairs and the reasons for and means of fostering change (Kudto et al., 2022).

Figure 1 The 'educational house' model of values and principles (see online version for colours)



Source: Östlund et al. (2007)

Figure 1 depicts the five guiding principles of a CDIO academic program, which include

1 the individual student in the flow of learning
2 knowledge and skills for appropriate action
3 following reality
4 visualisation
5 reflection.

The three common values of a CDIO academic program are

1 engineering and science for the betterment of society
2 respect for individuals and nature
3 eliminating waste.

From such common values and principles, the 'educational house' is built under the CDIO philosophy to make students aware of the 'state of normality' and understand abnormal states to standardise their way of learning and, in the future, working. The 'educational' house roof, to a certain extent, summarises the philosophy of the CDIO approach, that is 'continuous improvement', which means that "everyone involved in the program should always strive for continuous improvements, and which is highly important to stress, no improvement is too small to be neglected" (Östlund et al., 2007). Östlund et al. (2007) emphasised that improvements under the philosophy of the CDIO approach in teaching and learning should be frequent and small to avoid moving too far from the state of normality.

3.2 The CDIO 12 standards

The CDIO 12 standards to describe the CDIO program and to be used as the principles to develop CDIO academic programs were approved in January 2004 by the CDIO Initiative (http://www.cdio.org). These standards cover 12 aspects of an academic program, comprised of CDIO philosophy (standard #01), syllabus outcomes (standard #02), integrated curriculum (standard #03), introduction to engineering (standard #04), design-build experiences (standard #05), workspaces (standard #06), integrated learning experiences (standard #07), active learning (standard #08), enhancement of staffs CDIO skill (standard #09), enhancement of staff teaching skills (standard #10), CDIO skills assessment (standard #11), and CDIO program evaluation (standard #12).

Crawley et al. (2007) classified 12 CDIO standards into six fields to make them simpler, comprised of program philosophy (standard #01), curriculum development (standards #02, #03, and #04), design-build experiences, and workspaces (standards #05 and #06), teaching and learning methods (standards #07 and #08), faculty development (standards #09 and #10), and assessment and evaluation (standards #11 and #12) (Crawley et al., 2007). Leong (n.d.), an expert on the CDIO organisation, also classified these standards into six fields but with some differences, concretely CDIO philosophy (standard #01), curriculum (standards #02, #03, #04, and #05), workspaces/labs (standard #06), teaching and learning methods (standards #07 and #08), enhancement of faculty competence (standards #09 and #10), and assessment methods (standards #11 and #12).

4 Scope of the study

This study was conducted from May 2021 to September 2021 at the four universities administered by the Vietnam Ministry of Transport, comprised of the Ho Chi Minh City University of Transport, Vietnam University of Transport Technology, Vietnam Maritime University, and Vietnam Aviation Academy.

5 Methodology

This quantitative study applies the exploratory factor analysis (EFA, hereafter) with a Likert seven-point questionnaire to analyse the alumni' perspectives of the academic

program. To ensure the data collected from the questionnaire is valid and reliable, three requirements are made for the questionnaire consisting of

a the respondents are working in the field correspondent to the academic program

b all items in the questionnaire are responded to

c the responses will not be taken into analysis if all items in the questionnaire were chosen with only one point or two points repeatedly.

5.1 Participants

5.1.1 Participants in the pilot study

Thirty-two alumni from the four universities in the study were selected by the stratified probability sampling method to respond to the pilot questionnaire. The number meets the 10% requirement of the expected minimum sample for EFA statistics (Hill, 1998; Hertzog, 2008; Isaac and Michael, 1995; Lackey and Wingate, 1998; Nieswiadomy, 2002). Among these pilot questionnaire respondents, five alumni (four males and one female) graduated from the Vietnam University of Transport Technology, 17 alumni (14 males and three females) from Ho Chi Minh City University of Transport, five alumni (four males and one female) from Vietnam Maritime University, and five alumni (three males and two females) from Vietnam Aviation Academy.

5.1.2 Participants in the study

Four hundred and forty-eight alumni from the four universities in the study replied to the e-mail sent by the article author and answered the questionnaire attached to the e-mail. However, among these respondents, only 312 were taken into the analysis when the responses met the requirements of the study. Among 312 respondents, 82 respondents (53 males and 29 females) are from the Vietnam University of Transport Technology, 152 (114 males and 38 females) from Ho Chi Minh City University of Transport, 56 (39 males and 17 females) from Vietnam Maritime University, and 22 (eight males and 14 females) from Vietnam Aviation Academy. All of these respondents graduated from the universities in 2018 (66 respondents, 45 males, and 21 females), 2019 (50 respondents, 38 males, and 12 females), and 2020 (196 respondents, 131 males, and 65 females). The number of respondents generally reaches the researcher community's consensus (Gorsuch, 1983; Comrey and Lee, 1992) (Table 1).

5.2 Instrumentations

5.2.1 Scales to analyse alumni's perspectives

Based on the CDIO philosophy and 12 standards and the fields into which Crawley et al. (2007) and Leong (n.d.) classified these standards, the study designs six scales to investigate the alumni's perspectives of the academic program, comprised of:

- Scale expected learning outcomes, relating to standard #02, investigates the correspondence of specific, detailed learning outcomes for personal and interpersonal skills as well as disciplinary knowledge with the work requirements.

- Scale integrated curriculum, relating to standard #03, investigates the alumni's perspectives of the curriculum these alumni already learned on the integration between disciplinary courses with personal and interpersonal skills as well as with product, process and system building skills.
- Scale design-build experiences, relating to standards #04 and #05, investigates the alumni's perspectives of the curriculum these alumni already learned on the effectiveness of the introductory course providing the framework for engineering practice, essential personal and interpersonal skills and the progress from basic to advanced level experiences in the process of learning.
- Scale methods of teaching and learning, relating to standards #07 and #08, investigates the ways that the learning experiences that lead to the acquisition of disciplinary knowledge, personal and interpersonal skills, and teaching and learning based on active and experiential learning methods correspond to the work requirements.
- Scale faculty teaching skills, relating to standards #09 and #10, investigates the effectiveness of faculty competence in providing integrated learning experiences, improving students' personal and interpersonal skills on the work requirements.
- Scale assessment and evaluation, relating to standard #11, investigates the effectiveness of assessment and evaluation methods relating to disciplinary knowledge, personal and interpersonal skills and product, process, and system building skills.

Table 1 The distribution of the alumni responding to the questionnaire

University	*Proper respondents*		
	Total	*Male*	*Female*
Vietnam University of Transport Technology	82	53	29
Ho Chi Minh City University of Transport	152	114	38
Vietnam Maritime University	56	39	17
Vietnam Aviation Academy	22	8	14
Total	312	214	98

Thus, standards #01, #06, and #12 were not taken into consideration alumni's perspectives on the academic program when standard #01 mentions the CDIO philosophy, which is out of students' knowledge, and standard #06 mentions the material facilities of the universities, which belongs to the university, not the students, and standard #12 mentions to evaluating the academic program, which, again, belongs to the university, not the students (Jauhari, 2020).

5.2.2 Questionnaire

The questionnaire used in the study was edited from the pilot questionnaire and by applying reliability statistics with the coefficients of Cronbach's alpha and item-total correlations. The questionnaire was designed based on the following principles:

- Applying the Likert seven-point scale to make the choices reflect more exactly the respondents' attitudes in usability evaluation when the gaps between choices are smaller (Colman et al., 1997; Lewis, 1993; Preston and Colman, 1999).
- After the process of using reliability statistics with the item-total correlation coefficients, each scale has to consist of at least four items to make sure validity and reliability (Gliem and Gliem, 2003; Kline, 1986; Nemoto and Beglar, 2014; Samuel, 2015; Yurdugül, 2008).
- The order of items in the questionnaire is randomised and made sure two items belonging to one scale do not stand next to one another; this principle was done to avoid the way to answer an item being influenced by the previous item (Gliem and Gliem, 2003; Goodhue and Loiacono, 2002; Nemoto and Beglar, 2014; Prieto and Delgado, 1996).
- Some items, concretely items #05, #16 and #34, were written in the reversed sense to make sure the respondents focused on the answering scale (Abad, 2011; Nunnally, 1978; Paulhus, 1991; Prieto and Delgato, 1996; Swain et al., 2008).
- The Vietnamese version of the questionnaire was delivered to the respondents to ensure the respondents were able to understand the questionnaire completely (Nemoto and Beglar, 2014).

The questionnaire has two parts; the first part, with seven items, investigates the respondents' demographic information, in which item #07 *how would you evaluate the corresponding relation between the academic program you already learned and the working requirements in terms of professional ability, soft skills, and personal characteristics?*, is used as the dependent variable to consider the impacts of six scales, the independent variables, on the corresponding relation between the academic program and the work requirements.

Part two of the questionnaire has 39 items allotted in six scales as follows:

- Scale expected learning outcomes, relating to standard #02, has six items, comprised of items #03, #09, #14, #18, #22 and #27.
- Scale integrated curriculum, relating to standard #03, has six items, comprised of items #05, #10, #16, #25, #30 and #35.
- Scale design-build experiences, relating to standards #04 and #05, has six items, comprised of items ##07, #12, #33, #01, #20 and #37.
- Scale teaching and learning methods, relating to standards #07 and #08, has ten items, comprised of items #13, #19, #21, #24, #06, #26, #28, #31, #34 and #38.
- Scale faculty teaching skills, relating to standards #09 and #10, has five items, comprised of items #04, #11, #17, #23 and #39.
- Scale assessment and evaluation, relating to standard #11, has six items, comprised of items #02, #08, #15, #29, #32 and #36.

The Likert seven-point responding scale for 39 items in part 2 is from

1 completely disagree

2 disagree

3 moderately disagree

4 no idea

5 moderately agree

6 agree

7 completely disagree.

This responding scale is supposed to correspond to the Likert seven-point responding scale for item #07 of part 1.

5.3 Data analysis

Data collected from the responses were analysed by the software SPSS 25.0 with the method of EFA under three following steps:

Step 1 Define the factors with the principal component analysis with the following requirements:

- Kaiser-Meyer-Olkin index (KMO index, hereafter) must be from 0.500 to 1.000 (Hair et al., 1998; Kaiser, 1970) to ensure the correlations among variables are not too low for the factor model to be appropriate.
- Sig. value in Bartlett's test of sphericity must be ≤0.050 to reject the hypothesis stating that the variances are homogeneous.
- The cumulative rotation sums of squared loadings must be ≥50.00% (Hair et al., 1998; Gerbing and Anderson, 1988).
- The factor loadings of an observed variable must be ≥0.300 to ensure the observed variables are distinguished from one another (Jabnoun and Al-Tamimi, 2003; Hair et al., 1998).

Step 2 Test the reliability of every component in the questionnaire with reliability statistics:

- The Cronbach's alpha coefficient for each component must be from 0.700 to 0.899 to make sure the internal consistency of the responses is reliable (<0.700) and to make sure some questionnaire items not just test the same question but in a different guise (>0.899) (Boyle, 1991; Darren and Mallery, 2003; Gliem and Gliem, 2003; Salvucci et al., 1997; Tavakol and Dennick, 2011).
- The item-total correlation coefficient of each variable must be ≥0.300 (de Vaus, 2002; Hair et al., 1998; Tabachnick and Fidell, 2001).

Step 3 Consider the impact of each component explored in step 2 on the correspondence with the stakeholders' requirements by using multi-regression analysis to produce the regression model (Darren and Mallery, 2003; Gliem and Gliem, 2003; Hair et al., 1998; Snecdecor and Cochran, 1989; Walkins, 2018).

6 Results

6.1 EFA results

The process of running factor dimension reduction and reliability statistics in steps 1 and 2 of the EFA removes item #38 in the teaching and learning methods scale due to the factor loading requirement and item #18 in the scale of expected learning outcomes due to the item-total correlation requirement. Therefore, the variables taken into the linear regression analysis are 37 items. Table 2 reports the coefficients of Cronbach's alpha and item-total correlation of the six factors.

Table 2 The coefficients of Cronbach's alpha and item-total correlation of the variables in the six factors

Factors	*Variables*	*Cronbach's alpha*	*Item-total correlation coefficients*	
			Lowest	*Highest*
Teaching and learning methods	9	0.895	0.413 (#13)	0.824 (#24)
Integrated curriculum	6	0.825	0.553 (#30)	0.704 (#35)
Assessment and evaluation	6	0.753	0.405 (#15)	0.570 (#02)
Design-build experiences	6	0.728	0.303 (#20)	0.593 (#33)
Expected learning outcomes	5	0.738	0.436 (#09)	0.639 (#03)
Faculty teaching skills	5	0.709	0.408 (#04)	0.546 (#17)

Step 3, multi-regression analysis, of the EFA process between the six factorial variables, the independent variables, and the alumni's responses to item #07 in part 1 of the questionnaire, the dependent variable, produces three tables as the results of the analysis, comprised of

a model summary

b analysis of variables (ANOVA)

c coefficients to state the regression model of the study.

The process of running EFA also produces a KMO index of 0.734, Bartlett's test coefficient of 0.000, smaller than $p \leq 0.050$, and rotation sums of squared loadings of 50.90% to prove the model results to be valid and reliable for further analysis.

Table 3a summarises the results of the multi-regression analysis. According to the table, the R-value is 0.922, indicating a high degree of correlation between the independent variables and the dependent variable; the effect size or coefficient of determination R^2 is 0.851, stating that 85.10% of the total variation in the dependent variable (the corresponding relation) can be explained by the six factorial independent variables. Also, the adjusted R^2 is rather high with 0.848, equal to 84.80%, stating the high percentage of variation explained by only the independent variables that affect the dependent variable and indicating that the alumni's responses are close to the fitted values. However, the standard error of the estimate in the model summary is rather high at 0.679, expressing that when responding to the questionnaire items, the alumni diversify.

Table 3a Model summary for the multi-regression analysis

Model summary				
Model	*R*	*R-square*	*Adjusted R-square*	*Std. error of the estimate*
1	0.922[a]	0.851	0.848	0.679

Notes: [a]predictors: (constant), REGR factor faculty teaching skills, REGR factor expected learning outcomes, REGR factor design-build experiences, REGR factor assessment and evaluation, REGR factor integrated curriculum, REGR factor methods of teaching and learning.

Table 3b ANOVA results of the multi-regression analysis

ANOVA[a]						
Model		*Sum of squares*	*df*	*Mean square*	*F*	*Sig.*
1	Regression	802.201	6	133.700	289.788	0.000[b]
	Residual	140.719	305	0.461		
	Total	942.920	311			

Notes: [a]dependent variable: corresponding relation level.
[b]predictors: (constant), REGR factor faculty teaching skills, REGR factor expected learning outcomes, REGR factor design-build experiences, REGR factor assessment and evaluation, REGR factor Integrated curriculum, REGR factor methods of teaching and learning.

Table 3c Regression model

Coefficients[a]						
Model		*Unstandardised coefficients*		*Standardised coefficients*	*t*	*Sig.*
		β	*Std. error*	*Beta*		
1	(Constant)	*3.984*	0.038		103.602	0.000
	REGR factor teaching and learning methods	*0.904*	0.039	0.519	23.474	0.000
	REGR factor integrated curriculum	*0.673*	0.039	0.387	17.482	0.000
	REGR factor assessment and evaluation	*0.531*	0.039	0.305	13.781	0.000
	REGR factor design-build experiences	*0.715*	0.039	0.410	18.551	0.000
	REGR factor expected learning outcomes	*0.653*	0.039	0.375	16.967	0.000
	REGR factor faculty teaching skills	*0.299*	0.039	0.172	7.757	0.000

Note: [a]dependent variable: corresponding relation level.

Table 3b reports the ANOVA results of the multi-regression analysis. The sig. value 0.000, from F (6, 305) = 289.788, indicates that the regression model predicts the dependent variable significantly well and that the regression model statistically significantly predicts the outcome variable.

Table 3c provides the necessary information to predict the alumni's opinion towards the corresponding relation between the academic program and working requirements from the six scales. The values in the β column of the unstandardised coefficients prove that with the constant of 3.984, the effects that the six factors put on the dependent variable are, from the strongest down, teaching and learning methods (0.904), design-build experiences (0.715), integrated curriculum (0.673), expected learning outcomes (0.653), assessment and evaluation (0.531), and faculty teaching skills (0.299). The sig. column reports that all sig. values are 0.000, stating that the factors contribute statistically significantly to the model.

Thus, the regression equation can be formulated as follows:

$$\begin{aligned}&\text{Corresponding relation level of the training program with working requirements}\\&= 3.984 + (0.904 \times \text{teaching and learning methods})\\&+(0.723 \times \text{design-build experiences}) + (0.673 \times \text{integrated curriculum})\\&+(0.653 \times \text{expected learning outcomes}) + (0.531 \times \text{assessment and evaluation})\\&+(0.299 \times \text{faculty teaching skills}).\end{aligned}$$

6.2 Alumni's perspectives of the current academic program

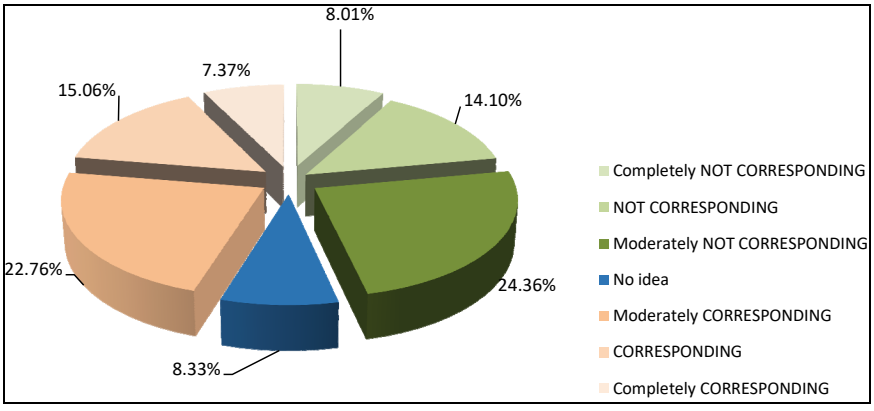
Figure 2 on the next page displays the distribution of the alumni's opinions towards the corresponding relation between the academic program the alumni were trained in and the working requirements when responding to item #07 of part 1 in the questionnaire. Upon the responding scale, 7.37% of the 312 alumni states 'completely corresponding', 15.06% for 'corresponding', 22.76% for 'moderately corresponding', 8.33% for 'no idea', 24.36% for 'moderately non-corresponding', 14.10% for 'non-corresponding', and 8.01% for 'completely non-corresponding'. Thus, the responses on the 'non-corresponding' side are slightly higher than the 'corresponding' side with 46.47% over 45.19%. The statistics express that the academic program that the alumni learned corresponds to the requirements of their current work only at the average level, slightly on the side of 'non-corresponding'.

As the regression equation states in Table 3c, the effect that the choices of 312 alumni to the responding scale of the questionnaire items put on the 'average' corresponding relation are, from the strongest down,

1 Teaching and learning methods (with β unstandardised value of 0.904 and related to CDIO standards #07 and #08).
2 Design-build experiences (0.715 and CDIO standards #04 and #05).
3 Integrated curriculum (0.673 and CDIO standard #03).
4 Expected learning outcomes (0.653 and CDIO standard #2).
5 Assessment and evaluation (0.531 and CDIO standard #11).
6 Faculty teaching skills (0.299 and CDIO standards #09 and #10).

These parameters provide clear evidence to the academic program designers of the four universities in the study when revising the academic program to approach the CDIO philosophy.

Figure 2 Distribution of the alumni's opinions towards the corresponding relation between the academic program and working requirements (see online version for colours)

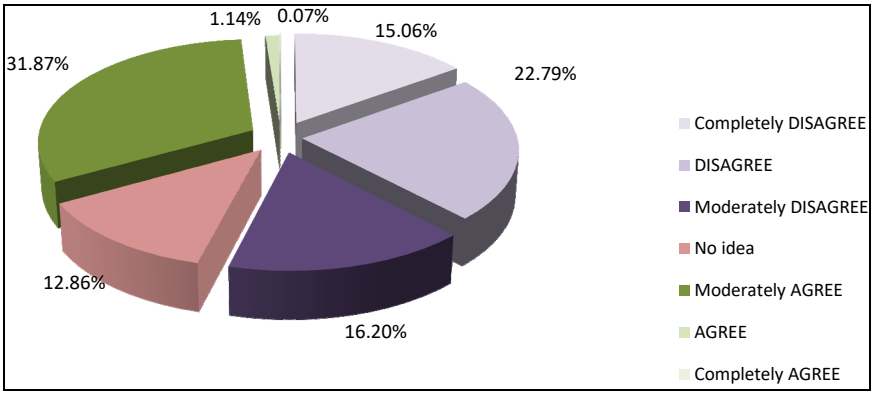


7 Discussion

7.1 On the scale of teaching and learning methods

Responding to the scale of teaching and learning methods which refers to standards #07 and #08 of the CDIO philosophy, 15.06% of the respondents tick off completely disagree, 22.79% disagree, 16.20% moderately disagree, 12.86% no idea, 31.87% moderately agree, 1.14% agree, and 0.07% completely agree. Thus, 54.06% of the respondents are on the 'disagree side', supposed to be tantamount to 'non-corresponding', and an overwhelming 33.08% of the respondents on the 'agree side' supposed to be tantamount to 'corresponding', as Figure 3 illustrates.

Figure 3 Distribution of the alumni's opinion towards items in the scale of teaching and learning methods (see online version for colours)



Generally, the alumni from the four universities in the study do not highly appreciate the methods of teaching and learning in the academic program when the aspect of the corresponding relation to the working requirements is taken into consideration, especially

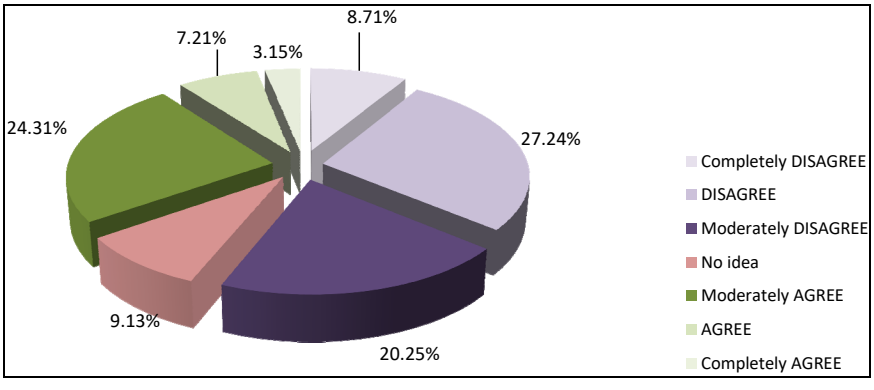
relating to training students' soft skills, only 34.62% agrees to item #06, 26.92% to item #26, and 33.33% to item #28 at different levels. Student's activeness, only 27.56% agree with item #13, 29.48% with item #21, and 33.65% with item #24 at different levels. It should be noteworthy that, on the 'agree side', most of the responses are for the choices of 'moderately agree' while just a few alumni tick off 'agree' choices, 1.14%, and 'completely agree', 0.07%. Having the strongest impact on the regression equation, which is tantamount to the highest correlation to the responses for item #07 of part 1, the alumni's opinions towards this scale need to be carefully concerned when the academic program approaches the CDIO philosophy is designed.

7.2 On the scale of design-build experiences

Taking the second place of the effective strength on the regression equation, the scale of design-build experiences has 56.20% of the responses on the 'disagree' side with 8.71% for 'completely disagree', 27.24% for 'disagree', and 20.25% for 'moderately disagree' and 34.67% on the 'agree' side with 24.31% for 'moderately agree', 7.21% for 'agree' and 3.15% for 'completely agree'. The option of 'no idea' gets 9.13% of the respondents.

Responding to the items in the scale, alumni's opinions display that the practice skills are partly emphasised by the academic program (items #07, #12, and #33 in the scale), however, the ways the lessons learned in class and the practice skills learned in workshops has not to combine strategically when only 25.00% of the respondents (all for 'moderately agree' choice) agrees to item #01. *The* academic program *integrates the lessons and practice effectively*, and 19.87% (again, all for 'moderately agree') to item #20 *the subjects relating to working knowledge from basic to advanced level in the course supported one another effectively and helped me to clearly understand the lessons* while the distributions are, respectively, 62.82% and 71.47%, on the 'disagree' side. Figure 4 illustrates the distribution of the responses to the scale of design-build experience in the questionnaire.

Figure 4 Distribution of the alumni's opinion towards items in the scale of design-build experiences (see online version for colours)



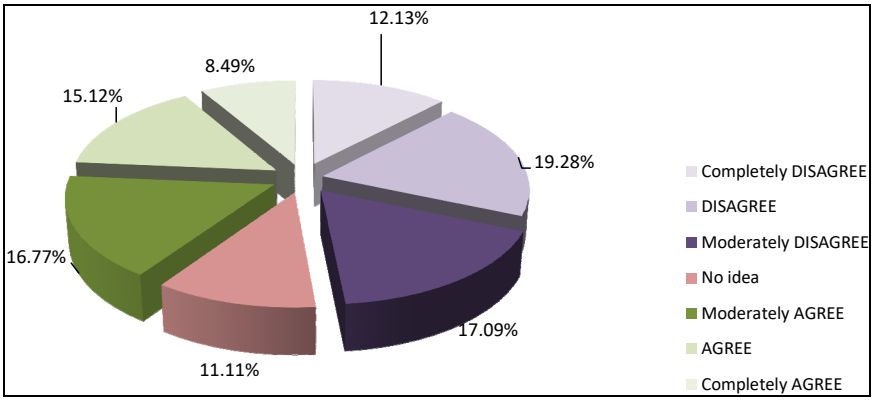
To some extent, the alumni's responses state that even though the practice skills have been emphasised in the course these alumni learned, the aspect of 'design-build experience' required by standards #04 and #05 of the CDIO philosophy has not been implemented totally, force the academic program designers at the four universities in the

study to review this aspect from the current academic program to a program approaching the CDIO philosophy.

7.3 On the scale of integrated curriculum

Figure 5 illustrates the distribution of the responses to the scale of the integrated curriculum in the questionnaire.

Figure 5 Distribution of the alumni's opinion towards items in the scale of integrated curriculum (see online version for colours)



Similar to the above scales, the scale of integrated curriculum, referring to standard #03 of the CDIO philosophy, also has the percentage for the 'disagree' side higher than that of the 'agree' side. Concretely, the 'disagree' side takes account for 48.50% of the respondents, comprised of 12.13% completely disagree, 19.28% disagree, and 17.09% moderately disagree, while the 'agree' side comprises 16.77% moderately agree, 15.12% agree, and 8.49% completely agree, 40.38% aggregately. Remarkably, when responding to the items in this scale, the respondents expressed their 'agree' attitude towards items #05 and #16, which are in the reversed sense, stating that the high amount of lessons force students to spend many hours in class and to learn the lesson by heart for the final exams. These statements, to a certain extent, contradict the CDIO philosophy. Conversed into the normal sense, these two items have 44.55% and 48.08% on the 'disagree' side. Other items, items #10, #25, #30 and #35, have the content stated in the CDIO philosophy referring to the characteristics of integrated curricula, and all get a higher percentage on the 'disagree' side.

7.4 On the scale of expected learning outcomes

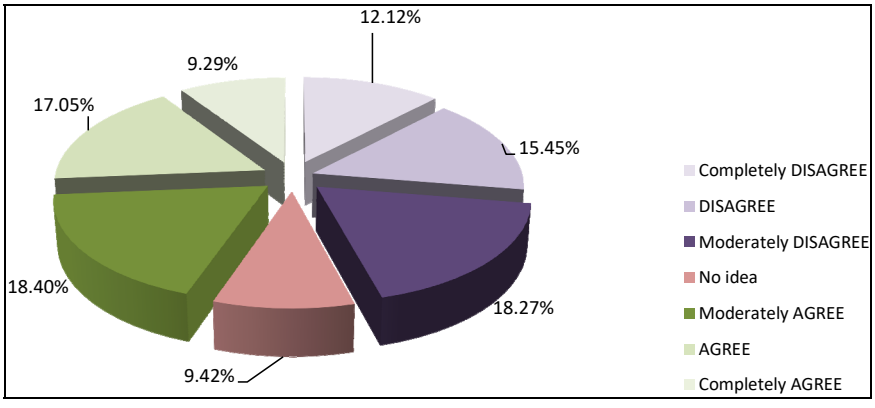
The scale of expected learning outcomes, referring to standard #02 of the CDIO philosophy, takes the third place to impact the corresponding relation between the academic program and working requirements. Besides 9.42% 'no idea' choices, the two sides of 'disagree' and 'agree' have a small difference of 1.09% when the 'disagree' side takes account for 45.83% of the responses, comprised of 12.12% completely disagree, 15.45% disagree, and 18.27% moderately disagree, and the 'agree' side for 44.74% of the

responses, comprised of 18.40% moderately agree, 17.05% agree, and 9.29% completely agree.

Noteworthily, while the requirements of learning outcomes relating to soft skills get a higher percentage of the respondents on the 'agree' side (items #14 and #22), the prominent percentage of the respondents ticked off the 'disagree' side of the items relating to the activeness (items #03 and #09).

Figure 6 illustrates the distribution of the responses to the scale of Expected learning outcomes in the questionnaire.

Figure 6 Distribution of the alumni's opinion towards items in the scale of expected learning outcomes (see online version for colours)



7.5 *On the scale of assessment and evaluation*

Among the six scales used to analyse alumni's perspectives of the corresponding relation, the scale of assessment and evaluation has the smallest difference with 0.85% between the percentage of the 'disagree' side, 46.85%, and the 'agree' side, 45.99%. With each point in the responding scale, the percentage is 7.37% for completely disagree, 17.25% for 'disagree', 22.22% for 'moderately disagree', 7.16% for 'no idea', 24.09% for 'moderately agree', 13.94% for 'agree', and 7.96% for 'completely agree'. Generally, the alumni's responses display that the methods of assessment and evaluation of the academic program that these alumni learned do not completely meet the requirements of the CDIO philosophy with standard #11 as the final exams were done chiefly with papers in class (item #29) and rather stressful to force students to apply much attempt to review the lessons (item #32), or students' soft skills were not included in the exams (item #08). On the other side, the new products are appreciated in the final exams with 39.42% on the 'disagree' side and 50.96% on the 'agree' side in item #36. This trend is in line with the CDIO philosophy.

Figure 7 illustrates the distribution of the questionnaire responses to the scale of assessment and evaluation.

Figure 7 Distribution of the alumni's opinion towards items in the scale of assessment and evaluation (see online version for colours)

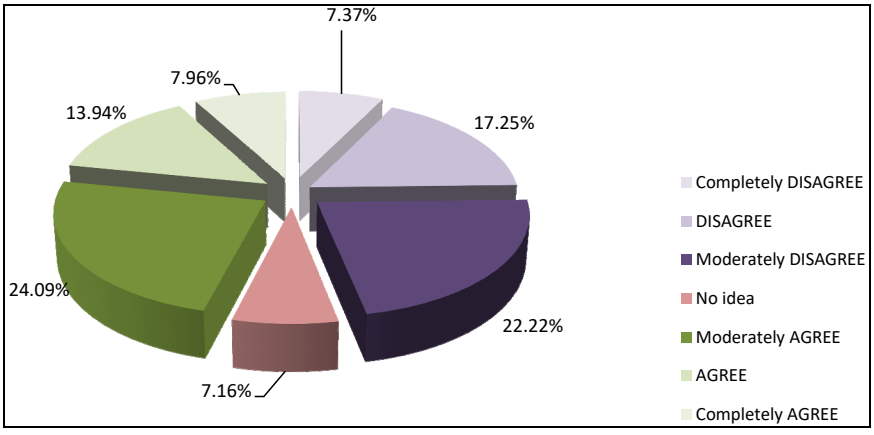
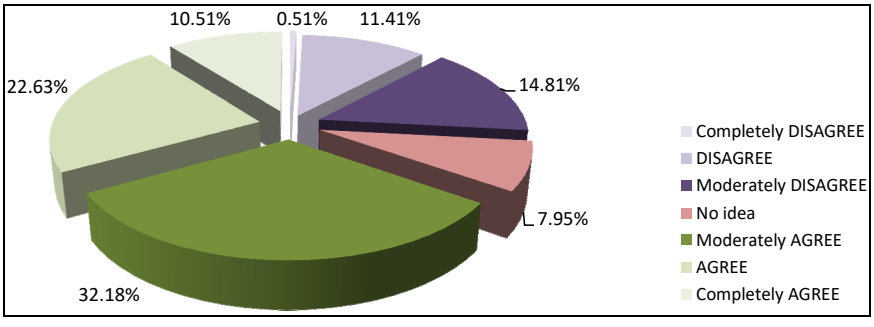


Figure 8 Distribution of the alumni's opinion towards items on the scale of faculty teaching skills (see online version for colours)



7.6 On the scale of faculty teaching skills

The alumni's responses to the survey can make the academic program designers of the four universities in the study feel secure when the percentage for the 'disagree' sides of five items on the scale is around 1/4 of the respondents. All of these item contents are in line with the CDIO philosophy. For the scale, up to 65.32% of the respondents states that they agree with the faculty's teaching skills, while only 26.73% of the respondents are on the opposite side, making the highest difference of 38.59% between the two sides. Concretely, 11.41% of the respondents ticked off 'completely disagree', 11.81% 'disagree', 7.95% 'moderately disagree', 7.95% 'no idea', 32.18% 'moderately agree', 22.63% 'agree', and 10.51% 'completely agree'. When the items in the scale are considered, some items get a high percentage on the 'agree' side as item #11, with 68.59% of the respondents agreeing to "my current working skills have improved by lecturers' instructions in the course", item #17 with 69.55% agreeing to "lecturers chiefly instructed students to use the brain rather than simply transferred the lessons", and item #23 with 63.46% agreeing to "lecturers paid much attention to students' acquisition." This scale is a good background for the four universities in the study to change the

current academic program to the academic program approaching the CDIO philosophy. Figure 8 illustrates the distribution of the responses to the scale of faculty teaching skills in the questionnaire.

8 Conclusions

This article reports the survey to investigate the perspectives relating to the corresponding relation between the academic program and the working requirements of the alumni of the four universities administered by the Vietnam Ministry of Transport, comprising the Ho Chi Minh City University of Transport, Vietnam University of Transport Technology, Vietnam Maritime University, and Vietnam Aviation Academy. The CDIO philosophy, with its 12 standards, is considered the approach that the academic program should be built up. Based on the six scales designed from the standards, comprised alphabetically,

1 assessment and evaluation

2 design-build experiences

3 expected learning outcomes

4 integrated curriculum

5 faculty teaching skills

6 teaching and learning methods, the survey finds that up to 46.47% of the alumni respond that the academic program that these alumni learned have not been corresponding to the working requirements while a smaller percentage of 45.19% of the alumni express the opposite idea.

Using EFA to explore the alumni's perspective, the study finds that the impacts that every scale has on the corresponding relation are, from the strongest down,

1 teaching and learning methods

2 design-build experiences

3 integrated curriculum

4 expected learning outcomes

5 assessment and evaluation

6 faculty teaching skills.

These parameters provide clear evidence to the academic program designers of the four universities in the study when revising the academic program to approach the CDIO philosophy.

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