

Critical issues and their solutions in the international accreditation of engineering and technology programmes in Taiwan

Lung-Sheng Lee†, Liang-Te Chang‡ & Kuen-Yi Lin*

National United University, Maioli, Taiwan†
De-Lin Institute of Technology, Taipei, Taiwan‡
HungKuang University, Taichung, Taiwan*

ABSTRACT: With the coming trend of ensuring graduates' competences, the issue of accreditation became increasingly popular from 1998 to 2002 as articles published in the *Journal of Engineering Education* demonstrate. The purpose of this study was to explore the critical issues and their solutions in the international accreditation of engineering and technology programmes in Taiwan based upon the Washington Accord. A literature review, in-depth interview, panel discussion and survey questionnaire were employed in this study to achieve the research purpose. There were 149 questionnaires distributed and 94 valid questionnaires were obtained, which led to a return rate of 63.1%. According to the results of analysis, the following two conclusions can be made: 33 critical issues have been identified and appropriate solutions to these issues developed; and compared to unaccredited engineering and technology programmes, accredited engineering and technology programmes have fewer difficulties in critical issues and generate a more positive attitude in solutions.

INTRODUCTION

In the mega-trend of global economic and international competition, more and more countries in recent years have expressed their needs for human resources to accommodate social change. These human resources have to be qualified with competences in problem solving, computer applications, data analysis and teamwork in dealing with future complicated problems [1]. Actually, these competences are related to engineering and technology education as demonstrated by the numerous position papers expressing the importance of engineering and technology education all over the world.

With the increasing trend to ensuring graduates' competences, the issue of accreditation became popular from 1998 to 2002 as demonstrated by papers published in the *Journal of Engineering Education* [2]. The ideal accreditation model comes from the Washington Accord; its focus is on recognising the substantial equivalency of accreditation systems of organisations holding signatory status and the engineering education programmes accredited by them [3]. Over the last decade, more and more countries want to become a signatory and ensure that their engineering and technology (ET) programmes foster graduates' competences using the Accreditation Board for Engineering and Technology (ABET). Taiwan follows this trend of accreditation.

Growing Demand for Accreditation in Taiwan

Taiwan is famous for electronic products and is known as the *Green Silicon Island*, so there is a great need for graduates of ET programmes in industry. However, graduates' performance in ET programmes does not always meet employers' needs. Therefore, the Institute of Engineering Education Taiwan (IEET) is driving the accreditation of ET programmes in Taiwan and trying to become a provisional signatory to the Washington Accord. In order to become a provisional

signatory, the IEET translated and revised the ABET standards, renaming it as the Accreditation Council 2004 (AC 2004) [4]. There have already been 88 ET programmes accredited with limitations and many ET programmes are still waiting for accreditation [5].

Identification of Critical Issues and Their Solutions are Vital to ET Programmes' Accreditation

Because more and more Taiwanese universities are interested to have their ET programmes gain AC 2004 accreditation, critical issues and their solutions need to be identified for continuous improvement. Therefore, the purpose of this study is to explore the critical issues and their solutions according to accredited and non-accredited ET programmes' experiences. It is believed that ET programmes in Taiwan or all over the world could take the results of this study as a reference point in applying for accreditation.

METHODOLOGY

Research Methods

A literature review was first conducted to develop a draft of critical issues and solutions in the international accreditation of ET programmes. Data were collected from the ABET Web site and the social science citation index by utilising the keywords of issues, solutions, engineering and technology, and accreditation. Finally, according to the literature review results, a draft of the critical issues and their solutions was made.

Because the draft of critical issues and their solutions developed in the literature review focused on international experiences, there might be some differences in applying for accreditation. Thus, in-depth interviews were employed to explore the real critical issues and their solutions in Taiwan. One dean and one programme head who had applied for

AC 2004 accreditation were invited to the in-depth interview and made many suggestions to the draft. Finally, the critical issues and solutions to those issues in Taiwan were developed after the in-depth interview.

A panel discussion was utilised to make the critical issues and their solutions in Taiwan more complete. Five programme heads were invited to the panel discussion on 5 May 2006, and they all had experience in preparing for accreditation. A questionnaire entitled *Critical Issues and Their Solutions in the International Accreditation of Engineering and Technology Programmes in Taiwan* was developed from the suggestions made by the panellists.

The questionnaire was employed to collect opinions from two cohorts of ET programme heads. Cohort 1 had experience in applying for accreditation conducted by the IEET. Cohort 2 had no experience in applying for accreditation. When a university/college had Cohort 1, its ET programmes having no experiences of applying for accreditation were counted for Cohort 2. There were 149 questionnaires distributed on 22 May 2006, and 63 valid questionnaires were obtained. A follow-up questionnaire was then distributed on 13 June 2006 with 94 valid questionnaires collected in total, leading to a rate of 63.1%. Among the 94 questionnaires, 36 questionnaires were collected from Cohort 1 giving a rate of 76.6%, and 58 questionnaires were collected from Cohort 2, yielding a rate of 56.9%. Finally, critical issues and their solutions were identified according to an analysis of the 94 questionnaires.

Research Tool

The major research tool was the questionnaire, *Critical Issues and Their Solutions in the International Accreditation of Engineering and Technology Programmes in Taiwan*. The validity of questionnaire was verified according to content validity. The Cronbach α value of reliability for the whole questionnaire was 0.95, while the Cronbach α value of the dimension of *critical issues* and *solutions to issues* were 0.94 and 0.93, respectively. That is, the whole questionnaire and its two dimensions were deemed to be reliable.

RESULTS

Among the 94 programme heads, 61 of them were affiliated to general universities/colleges and 33 of them were affiliated to universities/colleges of technology. Further, 49 of them were affiliated to public institutions and 45 of them to private ones. The average number of years of their working experiences and preparation length for accreditation were 2.2 ($SD=1.7$) years and 1.4 ($SD=0.6$) years, and the average degree in being familiar with accreditation was 7.0 on a nine-point scale.

According to the results listed in Table 1, the critical issues and their solutions in the international accreditation of engineering and technology programmes in Taiwan can be divided into the three stages: preparation, pushing and future stages.

Preparation Stage

There were four important issues in the preparation stage (listed in Table 1) with the most important issue being *the tasks of preparation are complicated* ($M=4.35$, $SD=0.99$). That is, if Taiwanese universities want to apply for the accreditation of their ET programmes, they may face the issue of the task of preparation being complicated. The solutions for each issue are

also shown in Table 1, with the appropriateness of each solution being acceptable. In other words, the solutions to issues could be taken as an important strategy to resolving issues during the preparation stage.

Pushing Stage

Five issues were identified in the pushing stage (see Table 1). In the *standards* aspect, only one issue was identified: *the meanings of AC 2004 standards need to be explained more clearly*. AC 2004 standards have been developed according to ABET standards, which are utilised to accredit ET programmes in Taiwan. This finding corresponds to Prados, Peterson and Lattuca's viewpoint, who believed that the ABET standards were complicated and user-unfriendly [6]. The solution developed for this issue is appropriate to be taken as an important strategy.

In the *institution* aspect, two issues were identified with the most important issue being *not enough resources*. That is, if the institutions wanted to pursue ET programmes for accreditation, they had to strive for enough resources. As for the solutions to these two issues, the solution to the second issue was found to be not so appropriate ($M=3.29$, $SD=1.17$). Therefore, it is necessary to develop the educational goals of the university/college in a step-by-step manner.

In the *programme* aspect, 12 issues were identified and the most important issue was *the tasks of accreditation are hard to be prepared in one time*. ABET published a follow-up report and the results showed that the process of accreditation should be focused on continuous improvement [7]. The solutions aimed at each issue are listed Table 1, with the appropriateness of each solution considered as acceptable. So these solutions can be taken as an important strategy to solving issues.

In the *teacher* aspect, five issues were identified; the most important was *teachers are overloaded with work*. According to this issue, the most appropriate solution is to allocate an assistant to help teachers prepare accreditation data. All solutions to the five issues were found to be acceptable and could be taken as an important strategy.

In the *other* aspect, only one issue was identified: *the status of graduates is hard to follow up*, and the two solutions to this issue and their appropriateness were great. These were to build up the follow-up system to the graduates system, and to make the alumni organisation and system more appropriate. Because graduates' performance is more and more important in recent years, it is also necessary to adopt these two solutions for monitoring a programme's performance.

Future Stage

There were two aspects of issues identified in the future stage, as shown in Table 1. In the IEET aspect, the most important issue being *the programmes do not leave enough time to prepare data for accreditation*. Therefore, the IEET should advance the operation time and then universities will have enough time to complete their work with their programmes in a timely manner. As for the solutions to issues, the appropriateness of each solution to issues was also found to be acceptable.

Regarding the AC 2004 aspect, the most important issue is *the Department of Education has no definite policy for*

Table 1: Analysis of the critical issues and solutions to these issues.

Critical Issues	M	SD	Rank	Solutions to Issues	M	SD
Preparation Period						
1. Building a common view is not easy	3.68	1.18	3	1. Hold conferences and invite experts to introduce accreditation	3.77	1.07
2. Research-oriented and senior teachers have a low willingness to join	3.32	1.21	4	2. Persuade teachers patiently	3.62	1.03
3. The tasks of preparation are complicated	4.35	0.99	1	3. Make up working teams effectively	4.11	1.11
4. The funding is not enough	3.89	1.20	2	4. Budget for the accreditation fee in advance	4.33	0.99
Pushing Period						
<i>Standards Aspect</i>						
The meanings of the AC 2004 standards need to be explained more clearly	3.57	1.06	1	Ask members of the IEET for advice	3.77	1.03
<i>Institution Aspect</i>						
1. Not enough resources	3.50	1.20	1	1. Ask the institution for help	4.02	1.12
2. The educational goals of the college/school are hard to develop in a short time	3.14	1.25	2	2. Utilise the school motto and develop educational goals through a formal process	3.29	1.17
<i>Programme Aspect</i>						
1. Inviting industry experts to join is hard	3.13	1.31	8	1. Invite outstanding education fellows to join	4.01	1.07
2. Clarifying accreditation details is hard	3.43	1.04	4	2. Invite experts to clarify questions	4.03	0.92
3. Developing programme standards according to AC 2004 is hard	3.26	1.11	6	3. Develop appropriate standards according to a programme's state of play and characteristics	4.14	0.87
4. Curriculum details are hard to be recognised	3.18	1.02	7	4. Design an appropriate form to present data	3.88	0.93
5. The tasks of accreditation are hard to prepare in one time	4.02	1.04	1	5. Improve continually	4.28	0.95
6. Cooperation between industry and the university/college is not balanced	3.11	1.20	9	6. Set up a permanent consultation committee	3.82	1.21
7. Insufficient room for the storage of evidence for accreditation	3.39	1.31	5	7. Convert accreditation data into an electronic form	3.97	1.01
8. The effects of the curriculum are hard to prove	3.61	1.06	3	8.1 Improve continually	4.21	.89
				8.2 Develop powerful tools to acquire persuasive data	4.00	.89
9. Students do not understand the benefits of accreditation	3.74	1.12	2	9.1 Make a handbook to clarify reasons	3.65	1.04
				9.2 Combine professional license and accreditation	3.66	1.18
10. Choosing one accreditation standard for a programme with two different fields is hard	3.02	1.38	10	10. Select the main accreditation standard and prepare for accreditation according to that standard	3.78	1.05
11. Variation of the programme's name after accreditation	2.47	1.41	12	11. Report to the IEET	3.41	1.28
12. Misconceptions of accreditation is equal to paperwork	2.85	1.35	11	12. The programme head should emphasise that accreditation is an approach to ensuring quality and continuous improvement	4.08	1.14
<i>Teacher Aspect</i>						
1. Teachers have a wait-and-see attitude about reform	3.56	1.07	3	1.1 Communicate continually	4.09	1.07
				1.2 Hold conferences to solve questions	3.81	1.14
				1.3 Invite senior experts to persuade teachers	3.84	1.14
2. Teachers have a low willingness to join	3.55	1.21	4	2. Invite persuasive experts to explain	3.67	1.19
3. The effects of teaching are hard to prove	3.64	1.12	2	3. Cooperate with educational assessment experts in developing evaluation tools and methods	3.80	1.02
4. Teachers are overloaded with work	3.94	1.17	1	4.1 Set up lower working loads	3.63	1.08
				4.2 Allocate assistants to help teachers prepare accreditation data	4.06	1.03
5. Setting up and transforming teaching goals are hard	3.51	1.00	5	5. Set up a permanent consultation committee to assist in the presentation of teaching results	3.96	1.05
<i>Other Aspect</i>						
The status of graduates is hard to follow up	3.85	1.35	1	1. Building the follow-up system of graduates	4.27	1.01
				2. Make education fellows' organisation and system more effective and efficient	4.20	1.02

Table 1 (continued).

Critical Issues	M	SD	Rank	Solutions to Issues	M	SD
Future Period						
<i>IEET Aspect</i>						
1. The programmes do not leave enough time to prepare data for accreditation	3.11	1.64	1	1. Advance the operation time	3.69	1.60
2. Accreditation committee members change the required documents without advance notice	2.87	1.42	2	2. Accreditation committee members have to make sure to identify all the required data in advance	3.93	1.19
3. Accreditation committee members are recruited inappropriately	2.67	1.60	4	3.1 Hire accreditation committee members carefully	3.85	1.29
				3.2 Clarify accreditation committee members' misunderstandings between accreditation and assessment	3.80	1.31
4. Some programmes have no related standards to be accredited	2.85	1.54	3	4. Refer the question to the Washington Accord	3.49	1.33
<i>AC 2004 Aspect</i>						
1. Not a signatory to the Washington Accord	3.43	1.66	4	1. Become a signatory to the Washington Accord as soon as possible	3.99	1.44
2. Promoting accreditation is not easy	3.46	1.39	3	2.1 Support accreditation by offering a reward or excusing assessment	4.09	1.21
				2.2 Combine with teacher evaluation	3.89	1.35
				2.3 Combine accreditation with professional technicians' examination	3.68	1.38
3. The relationship between accreditation and assessment is hard to clarify	3.56	1.42	2	3. Continually clarify accreditation and assessment through advertisements	4.07	1.08
4. The Department of Education has no definite policy for accreditation	3.63	1.54	1	4. Suggest that the Department of Education supports accreditation	4.21	1.17

accreditation. That is, universities hoped that the educational authority could assist in the accreditation process for their programmes and offer some benefits to them. The other solutions were also appropriate for each issue. In sum, 33 issues were identified and solutions to each issue were also developed in this study. Universities applying for accreditation of their ET programmes can use the results of this study as a reference to choose the most appropriate strategy.

Differences in Critical Issues and Solutions between Accredited ET Programmes and Unaccredited ET Programmes

According to the results shown in Table 2, differences in the critical issues between accredited ET programmes and unaccredited ET programmes include *developing standards of programmes according to AC 2004 is hard* ($t=-2.40, p=0.02$) and *the status of graduates is hard to follow up* ($t=-2.23, p=0.03$). Therefore, accredited ET programmes had fewer difficulties developing programme standards and following up graduates' status. So unaccredited ET programmes can ask accredited ET programmes for help in these two issues.

According to the results listed in Table 3, differences in issue solutions between accredited ET programmes and unaccredited ET programmes include *to improve continually* ($t=2.04, p=0.04$), *to set up a permanent consultation committee* ($t=2.23, p=0.03$), *to communicate continually* ($t=2.00, p=0.04$), *to set up a permanent consultation committee to assist in the presentation of teaching results* ($t=2.18, p=0.03$), *to support accreditation by offering a bounty or excusing assessment* ($t=2.53, p=0.01$), and *to combine with teacher evaluation* ($t=3.72, p=0.00$). Therefore, accredited ET programmes were perceived more positively regarding six solutions to the key issues. So the developers of accredited ET programmes had more experience in utilising the six solutions to the issues mentioned above.

CONCLUSIONS

With the increasing trend of ensuring graduates' competences, the critical issues of accreditation has become more popular. The purpose of this study was to explore the critical issues and solutions to issues according to accredited and unaccredited ET programmes' experiences.

Through the process of the literature review, in-depth interviews, panel discussion and survey questionnaire, 33 critical issues were identified for the three stages of preparation, pushing and future. More than one solution was developed in order to face each critical issue. Therefore, if universities seek international accreditation for their ET programmes, the critical issues and their solutions identified and developed in this study could be taken as a reference.

According to the results of analysis, accredited ET programmes exhibit fewer difficulties in critical issues and more positive attitudes towards solutions. Therefore, if the developers of unaccredited ET programmes want to apply for international accreditation, they can invite the heads of accredited ET programmes as experts. ET programme heads had more experience in facing critical issues of international accreditation and resolving them.

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Table 2: Differences in the critical issues between accredited and unaccredited ET programmes.

Critical Issues	Accredited ET Programmes		Unaccredited ET Programmes		<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Preparation Period					
1. Building a common view is not easy	3.67	1.20	3.69	1.19	-0.09
2. Research-oriented and senior teachers have a low willingness to join	3.28	1.00	3.34	1.33	-0.26
3. The tasks of preparation are complicated	4.47	0.81	4.28	1.09	0.93
4. The funding is not enough	3.83	1.11	3.93	1.25	-0.38
Pushing Period					
<i>Standards Aspect</i>					
The meanings of the AC 2004 standards need to be explained more clearly	3.78	0.83	3.45	1.17	1.59
<i>Institution Aspect</i>					
1. Not enough resources	3.47	1.08	3.52	1.27	-0.18
2. The educational goals of the college/school are hard to develop in a short time	3.14	1.20	3.14	1.29	0.00
<i>Programme Aspect</i>					
1. Inviting industry experts to join is hard	3.14	1.25	3.12	1.36	0.07
2. Clarifying accreditation details is hard	3.28	0.94	3.52	1.10	-1.08
3. Developing programme standards according to AC 2004 is hard	2.92	1.05	3.47	1.10	-2.40*
4. Curriculum details are hard to be recognised	3.00	0.99	3.29	1.03	-1.37
5. The tasks of accreditation are hard to prepare in one time	3.94	0.98	4.07	1.07	-0.56
6. Cooperation between industry and the university/college is not balanced	3.08	1.18	3.12	1.23	-0.15
7. Insufficient room for the storage of evidence for accreditation	3.39	1.29	3.40	1.32	-0.03
8. The effects of the curriculum are hard to prove	3.56	0.94	3.64	1.13	-0.37
9. Students do not understand the benefits of accreditation	3.61	1.13	3.83	1.11	-0.91
10. Choosing one accreditation standard for a programme with two different fields is hard	3.14	1.38	2.95	1.38	0.65
11. Variation of the programme's name after accreditation	2.56	1.36	2.41	1.45	0.47
12. Misconceptions of accreditation is equal to paperwork	2.72	1.32	2.93	1.37	-0.73
<i>Teacher Aspect</i>					
1. Teachers have a wait-and-see attitude about reform	3.44	0.97	3.64	1.13	-0.85
2. Teachers have a low willingness to join	3.36	1.07	3.67	1.28	-1.22
3. The effects of teaching are hard to prove	3.47	1.16	3.74	1.09	-1.14
4. Teachers are overloaded with work	3.78	1.17	4.03	1.17	-1.03
5. Setting up and transforming teaching goals are hard	3.58	0.97	3.47	1.03	0.55
<i>Other aspect</i>					
The status of graduates is hard to follow up	3.44	1.50	4.10	1.19	-2.23*
Future Period					
<i>IEET Aspect</i>					
1. The programmes do not leave enough time to prepare data for accreditation	3.39	1.29	2.93	1.81	1.43
2. Accreditation committee members change the required documents without advance notice	2.97	1.25	2.81	1.52	0.54
3. Accreditation committee members are recruited inappropriately	2.83	1.42	2.57	1.70	0.78
4. Some programmes have no related standards to be accredited	2.61	1.36	3.00	1.63	-1.20
<i>AC 2004 Aspect</i>					
1. Not a signatory to the Washington Accord	3.75	1.54	3.22	1.71	1.51
2. Promoting accreditation is not easy	3.75	1.05	3.28	1.54	1.77
3. The relationship between accreditation and assessment is hard to clarify	3.81	1.09	3.41	1.58	1.42
4. The department of education has no definite policy for accreditation	3.86	1.22	3.48	1.71	1.25

Table 3: Differences in the solutions between accredited and unaccredited ET programmes.

Solutions to Issues	Accredited ET Programmes		Unaccredited ET Programmes		<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Preparation Period					
1. Hold conferences and invite experts to introduce accreditation	3.78	1.02	3.76	1.11	0.08
2. Persuade teachers patiently	3.54	0.95	3.67	1.07	-0.56
3. Make up working teams effectively	4.33	0.79	3.97	1.26	1.57
4. Budget for the accreditation fee in advance	4.36	0.87	4.31	1.06	0.24
Pushing Period					
<i>Standards Aspect</i>					
Ask members of the IEET for advice	3.58	1.08	3.89	0.99	-1.42
<i>Institution Aspect</i>					
1. Ask the institution for help	4.06	1.01	4.00	1.18	0.23
2. Utilise the school motto and develop educational goals through a formal process	3.21	1.12	3.33	1.20	-0.50
<i>Programme Aspect</i>					
1. Invite outstanding education fellows to join	4.25	0.87	3.86	1.16	1.72
2. Invite experts to clarify questions	3.92	0.91	4.10	0.93	-0.96
3. Develop appropriate standards according to a programme's state of play and characteristics	4.25	0.77	4.07	0.92	0.97
4. Design an appropriate form to present data	3.97	0.77	3.83	1.01	0.73
5. Improve continually	4.53	0.70	4.12	1.06	2.04*
6. Set up a permanent consultation committee	4.14	0.96	3.61	1.31	2.23*
7. Convert accreditation data into an electronic form	4.06	0.86	3.91	1.10	0.66
8.1 Improve continually	4.31	0.82	4.16	0.93	0.79
8.2 Develop powerful tools to acquire persuasive data	4.03	0.81	3.98	0.95	0.24
9.1 Make a handbook to clarify reasons	3.75	0.84	3.59	1.16	0.74
9.2 Combine professional license and accreditation	3.74	0.98	3.61	1.29	0.53
10. Select the main accreditation standard and prepare for accreditation according to that standard	3.94	0.81	3.68	1.16	1.16
11. Report to the IEET	3.58	1.18	3.30	1.34	0.96
12. The programme head should emphasise that accreditation is an approach to ensuring quality and continuous improvement	4.26	1.01	3.96	1.21	1.20
<i>Teacher Aspect</i>					
1.1 Communicate continually	4.36	0.80	3.91	1.18	2.00*
1.2 Hold conferences to solve questions	3.92	1.00	3.74	1.23	0.74
1.3 Invite senior experts to persuade teachers	3.78	1.07	3.88	1.18	-0.41
2. Invite persuasive experts to explain	3.72	1.21	3.63	1.19	0.36
3. Cooperate with educational assessment experts in developing evaluation tools and methods	3.81	0.86	3.79	1.12	0.06
4.1 Set up lower working loads	3.74	0.95	3.55	1.16	0.81
4.2 Allocate assistants to help teachers prepare accreditation data	4.11	0.95	4.04	1.09	0.35
5. Set up a permanent consultation committee to assist in the presentation of teaching results	4.25	0.77	3.78	1.16	2.18*
<i>Other aspect</i>					
1. Building the follow-up system of graduates	4.44	0.81	4.16	1.11	1.36
2. Make education fellows' organisation and system more effective and efficient	4.44	0.81	4.05	1.11	1.83
Future Period					
<i>IEET Aspect</i>					
1. Advance the operation time	4.00	1.47	3.48	1.66	1.52
2. Accreditation committee members have to make sure to identify all the required data in advance	3.88	1.34	3.96	1.09	-0.30
3.1 Hire accreditation committee members carefully	4.09	1.10	3.68	1.40	1.40
3.2 Clarify accreditation committee members' misunderstandings between accreditation and assessment	4.00	1.15	3.65	1.41	1.19
4. Refer the question to the Washington Accord	3.69	1.23	3.37	1.39	1.05
<i>AC 2004 Aspect</i>					
1. Become a signatory to the Washington Accord as soon as possible	4.23	1.48	3.81	1.39	1.31
2.1 Support accreditation by offering a reward or excusing assessment	4.47	0.84	3.84	1.34	2.53*
2.2 Combine with teacher evaluation	4.44	0.84	3.53	1.50	3.72*
2.3 Combine accreditation with professional technicians' examination	3.94	1.15	3.50	1.50	1.51
3. Continually clarify accreditation and assessment through advertising	4.31	0.79	3.91	1.21	1.74
4. Suggest that the Department of Education supports accreditation	4.47	0.91	4.02	1.30	1.80