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An Investigation into the Role of Engineering and Technical Education in Providing the Skills Needed by Libyan Manufacturing Industry*

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The Libyan manufacturing industry has traditionally suffered from a shortage of skilled manpower. In 1990s, a network of Technical and Vocational Education and Training (TVET) institutions were introduced for the purpose of enhancing the supply of skilled manpower needed for the economic and social transformation plans. The aim of this study is to investigate the effectiveness of the Libyan TVET system in providing the skills needed by the national manufacturing industry. To achieve this goal a questionnaire has been designed to test the research hypothesis, and distributed to students in institutes of higher education; and engineers and technicians employed in manufacturing industry in Libya to explore their views in this regard. The study indicated a direct relationship between the needs of the industrial sector and technical disciplines. The results of the research indicated that there is a substantial mismatch between the outcome of TVET and the exact requirements of manufacturing industry. The analysis of available statistics, however, suggests the unplanned nature of the link between the TVET and manufacturing industry. The results also indicated how to improve technical programmes which will help serve the community by providing students with adequate technical information.

Keywords: developing countries; Libya; TVET; partnership with industry

1. INTRODUCTION

AS IN MANY OTHER COUNTRIES, TVET in Libya has experienced massive expansion in the last ten years or so [1]. However, despite the significant and positive impacts of this expansion on the whole society, a number of analysts argue that TVET institutions have increased in number at the expense of qualitative aspects. They have further argued that the Higher Education Institutions (HEIs) in general, and TVET in particular suffer from a lack of appropriate planning mechanisms and procedures [1, 2].

TVET is an important sub-sector of the public education system. It has been subjected to an active process of redesigning, such as changing the curricula to meet the demands of the labour market for skilled manpower, and has become the focus of government strategy for developing skilled human resources in recent years [3, 4]. Libyan manufacturing industry has traditionally suffered from a shortage of skilled manpower [5]. This problem has become more pronounced during the past few decades, as the country attempted to keep pace with technological developments affecting many developing countries [5]. Consequently, to address this critical issue a network of TVET institutions was introduced in Libya, during the1990s for improving the supply of skilled manpower needed by manufacturing industry and fulfilment of socio-economic transformation plans. By 2000 there were 84 TVET institutions across the country, which increased to more than 120 institutes in 2004—an increase of 70% within four years [6, 7]. TVET is offered by post-secondary institutions. Since Libya needs more experts in the fields of engineering and technology, TVET institutions continue to train and produce a significant number of graduates in these fields.

Research [1–4, 8–11] on Libyan higher education and TVET has provided evidence that higher education and TVET graduates do not satisfy the demand of the manufacturing sector. Furthermore, the lack of strategic collaboration between higher education and TVET institutions, on the one hand, and manufacturing industry, on the other, has resulted in graduates that are not 'fit for purpose'. This is an important issue because manufacturing sector contributes, together with the construction industry, around 20% of Libyan GDP [12].

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2. TECHNICAL AND VOCATIONAL EDUCATION AND TRAINNIG IN LIBYA

Libya has paid more attention to the administration reform of TVET during the past ten years or so. For example, the Libyan government has established many new TVET institutions, reviewed organisational structures of existing institutions and sent abroad many people in order to gain skills and knowledge [11, 13].

Libya has considered TVET as one of the most important factors leading towards the solution of the nation's shortage of skilled workers in many sectors, so its important role in economic and industrial development cannot be easily ignored [14]. It is part of the formal education system and its main aims are to provide students with certain basic skills and knowledge and to supply them with the necessary tools to increase and update their knowledge through the lifelong education process, as well as to deliver and support the Libyan industrial sector with the provision of skilled and knowledgeable technicians.

The literature [9] indicates that at the beginning of the 1980s, the Libyan government reckoned TVET to be worth greater attention; hence, it embarked on the idea of technical education by establishing and developing several institutes of higher technical specialisation. TVET has been considered by the government as the main supplier of highly skilled manpower as well as accelerated economic growth and social development [7].

Since the mid-1980s, the country has experienced unprecedented expansion in this type of HEIs; it evaluated its entire educational system and found that student admissions in universities were very high in the pure academic studies: social sciences, literature, law, and the arts which contributes about 60 per cent or more in a society with a population of 5.6 million people (2006 census) and to fewer than half a million students [15]. In contrast, admissions were very low in basic sciences, technology, and engineering. This imbalance did not help Libya's industrial development.

The number of colleges increased from 54 in 1995/96 to a countrywide network of 84 TVET in 2000 with a growth rate of 55.5 per cent [9], and by the year 2004 the number of TVET institutions has increased to more than 120 institutes—an increase of 70 per cent [6]. Moreover, the number of HEIs has increased considerably from one university and four TVET in 1970 to 11 universities and 15 TVET institutions in 1989/1990. By the year 2000 this number had reached 14 universities with 76 faculties and 84 TVET institutions [9]. More than 300 scientific sections and departments were opened in these universities in the academic year 2004/05 [15].

In addition, total enrolments in TVET institutions had increased from 27,584 to 64,970 students between 1995/96 and 1999–2000; a growth rate of 131 per cent. The number of students in universities also increased from 165,447 in 1998/99 to 279,150 in 2006/07 [15]. In the academic year 1999/2000 the number of academics reached 4,907 in universities and 4,898 in higher technical institutes [9, 16].

In spite of this, the TVET number has increased substantially during the last ten years or so, but there are still some embedded problems in the system that affect its performance. TVET institutions which are considered the main supplier of highly skilled manpower, did not succeed in attracting more students as most secondary graduates prefer academic HEIs. On the other hand, they did not produce the required graduates both qualitatively and quantitatively. This can be attributed to the unplanned nature of the establishment of the TVET in terms of physical and human resources and poor links with manufacturing industry in particular [2, 10].

3. PARTNERSHIP WITH INDUSTRY

Providers of TVET should use a wide range of methods including joint venture with industry and summer courses to link learning and industry.

Successful partnerships between TVET providers and industry are essential to the national economy [17]. The purpose of working with industrial companies is to develop the TVET curriculum [18]. It is argued that a good relationship between the university and industry facilitates the placement of students for training and provides case studies for enriching the delivery of the curriculum[19]. Some type of industry supervision should be offered by the training place, while university staff may pay visits to follow the progress of students during their time in industry [19].

It is also clear that the development of the graduate engineer cannot be a classroom-based experience; rather it requires the specific involvement and commitment of industry to be involved with engineering programmes. One of the strategies in order to achieve this is through the development of partnerships between industry and education [20]. TVET linkages with Industry can clearly involve a wide range of mechanisms and activities, from providing national policy direction and identifying skill needs, to setting skill standards and adding technical input to teaching and learning resources [21]. However, TVET policy design and delivery should be achieved through a new partnership between government, employers, professional associations, industry and employees [22].

To make best use of resources and provide high quality TVET for students, it is essential that the TVET system and manufacturing industry work together. This collaboration should include directing resources towards occupational and career preparation where there is the greatest need and opportunity [23, 24]. Industry partners believe that the strength of their relationships with training institution is central to creating relevant skills and knowledge [18].

4. METHODOLOGY

This research is exploratory and descriptive in nature and the main method was quantitative (questionnaire survey). The data used in this study were based on a survey conducted among nine HEIs (Universities/Institutes) and manufacturing industry between March and June 2008 in Libya. To fulfil the objectives of this study, quantitative data using a questionnaire were generated to obtain information to examine the topic. The questionnaire aimed to elicit the students' perception of the skills and knowledge they are acquiring during their study at the engineering departments in different Libyan HEIs, and the engineers and technicians working in manufacturing industry about the education and training they received before joining the organisation. The questionnaire was administered to students in the above mentioned nine HEIs and engineers and technicians in manufacturing industry. The questionnaire consisted of 44 and 42 questions for students and engineers respectively, using closed questions that elicited detailed information from the study respondents. These questions were designed to obtain information concerning the following, as shown in Table 1.

The questionnaire used a six-point Likert scale style format; the majority of questions were written as attitude statements. This format allows the students and engineers to place themselves on an attitude continuum for each statement, running from 'Strongly Disagree', 'Disagree', 'Slightly Disagree', 'Slightly Agree', 'Agree', to 'Strongly Agree' [25].

The population from which the subjects were selected was 4,425 first and second year students at nine HEIs registered for the academic year of 2007–8; and for almost 1,150 engineers and technicians employed in manufacturing industry. To ensure sufficient representation from the target population, proportional stratified sampling was employed [26]. The total sample size of students, engineers and technicians was determined based on the table developed by Krejcie & Morgan [27]. The table gives a sample size of 708 for students and 217 for engineers and technicians.

A total of 958 questionnaires were distributed for both sectors, 762 were returned (625 and 137 for students and engineers respectively), and this represented a high response rate (85% for students and 61% for engineers). The results of partnership with industry were analysed and are presented in this paper.

5. RESULTS AND DISCUSSION

5.1 Characteristics of students, engineers and technicians

Results indicated that out of the 625 student sample, 50.7% were males and 49.3% were females. The greater majority of respondents belonged to the traditional student's age group, i.e. less than 26 years old (92.5%) and the remaining (7.5%) were 26 years old or over. About three-fifths (60.8%) of students surveyed were preparing for their 'Bachelor Degree' and almost two-fifths (39.2%) were preparing for their 'Higher Diploma'. The majority of students (86.7%) were full time and the remaining 13.3% were part-time students. 59.5% of the students' fathers were government workers; 62% of the mothers were housewives (see Appendix A).

The engineers' questionnaire showed that of the 137 respondents, the vast majority 97.1% were Libyans and the remaining 3% were Arab and African nationals. The majority (98.5%) were male and 1.5% were female. Most (85.4%) were between 30 and 50 years old, 2.9% were under 30 years and 11.7% were over 50 years. About one-fifth (20.4%) of the respondents held a Bachelor degree, 56.2% of them held technical diploma degrees and the remaining 23.4 held secondary school certificate. The majority of respondents (69.4%) had a work experience of between 5 and 20 years; 21.9% of them had more than 20 years experience and 8.8% had less than five years. Most (69.3%) of the respondents indicated that their current job was their first job after graduation. The remaining 30.7% of them had a second or more jobs after graduation (see Appendix B).

5.2 Partnership with industry—students' perception

(Q1) Linkage of course studied to the relevant industry

Figure 1 illustrates that only a minority of the students (17.7%) agreed that their course is linked to the relevant industry. In contrast, 45.0% of them disagreed, and 37.5% either slightly agreed or

Table 1. Component of students, engineers and technicians questionnaire

Subject Areas Measurement of Students	No. of Items	Subject Areas Measurernt of Engineers and Technicians	No. of Items
Strategies and Policies	6	Strategies and Policies	8
Curriculum Design	8	Education and Training before Employment	6
Curriculum Delivery	9	Delivery of Education and Training	6
Partnership with Industry	4	Partnership with TVET Providers	6
Accreditation	1	Accreditation	2
Quality Assurance	10	Quality Assurance	9
Staff Development	3	Staff Development	2
Cultural Aspects	3	Cultural Aspects	3

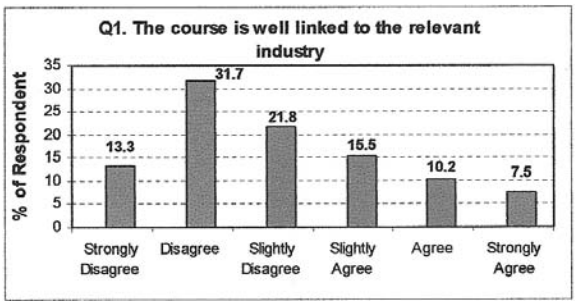

Fig. 1. Students' perception of linkage between courses studied and relevant industry.

slightly disagreed. This clearly indicates that the curriculum delivered is not well designed and that there is a rather poor link between course design by the HEIs and the relevant industry.

This pattern of responses substantiates the authors' view that the curriculum and subjects taught might need extra practical work and further training to help them respond to the aspirations and requirements of their jobs in the future. This is also in agreement with the literature concerning the Libyan education system which reported that the Libyan education system is not providing the skills required to drive the economy forward [28]. The pattern of responses also reveals the poor quality of curricula, teachers and infrastructure and recent literature maintains that curricula must be designed to match the needs of students and to cater for their aspirations and requirements [29].

(Q2) Lectures presenting case studies from industry

While 28.7% of the respondent students agreed that lectures delivered during the course present case studies, 43.4% of them disagreed and 27.9% of them were undecided (Figure 2). This pattern of responses might suggest that more lectures have not presented case studies from relevant industries. This pattern also clearly demonstrates the poor or inadequate practical application of theory and the poor design of the curriculum. Furthermore, it demonstrates the poor linkage between HEIs and the relevant industry which will recruit these students after graduation. This raises the concern that HEIs need to liaise with industry to help design and deliver an adequate curriculum that helps students in their future career. Responses may also reflect an imbalance between theory and practice in the delivered curriculum.

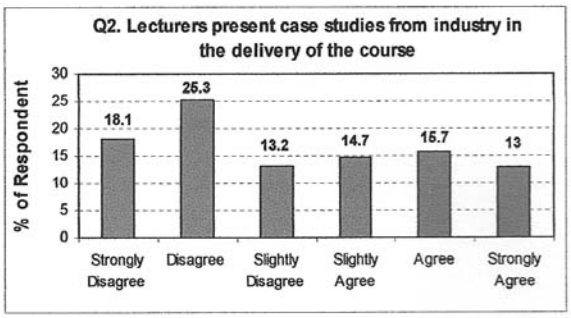

Fig. 2. Students' perception of lectures presenting case study from industry.

(Q3) Students' perceptions of visiting industrial sites relevant to their study

When asked whether they enjoy visiting industrial sites that are relevant to their study, more than half of responding students indicated their agreement, in contrast to 25.6% of them who did not enjoy visiting such sites (Figure 3). A minority of 16.0% of students were either slightly agreeing or slightly disagreeing. On the whole, it can be said that most students enjoyed such visits, possibly they felt that these visits would give them an idea of the nature and type of work carried out on these sites, and also give them some practical insight of the job that they might have after graduation. These visits would increase students' knowledge and can prepare them for their future career.

(Q4) Students' training in relevant industry as part of their study

Most of the respondent students (71.2% of the sample) indicated that they like to spend time on training in an industry relevant to their study, in contrast to a minority of 11.0% of them who disagreed with it and 18.5% of them who were either slightly agreeing or slightly disagreeing (Figure 4). Spending time on training in relevant industry is very important for engineering students so they see at first hand how they are expected to do their jobs after graduation and recruitment by the industry.

5.3 Partnership with higher education and vocational training institutions—perception of engineers and technicians

(Q5) TVET institutions' role in updating and enhancing their skills

About 40.0% of respondents agreed that TVET institutions play a key role in updating and enhancing their skills, whereas many of them (37.8% of the sample) slightly agreed or slightly disagreed. Around 20.0% of these indicated their disagreement with the statement (Figure 5). Given that the

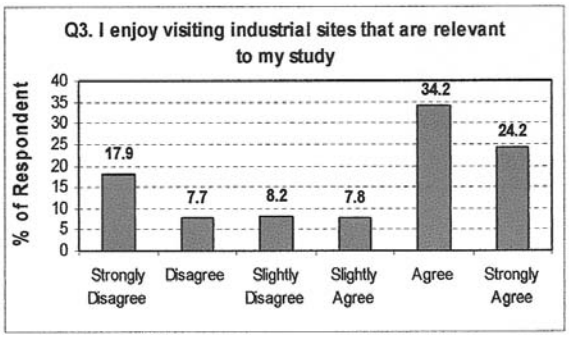

Fig. 3. Students' perception of visiting industrial sites relevant to their study.

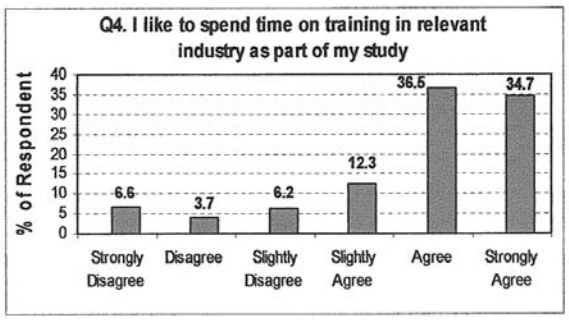

Fig. 4. Students' perception of their training in industry as part of their study.

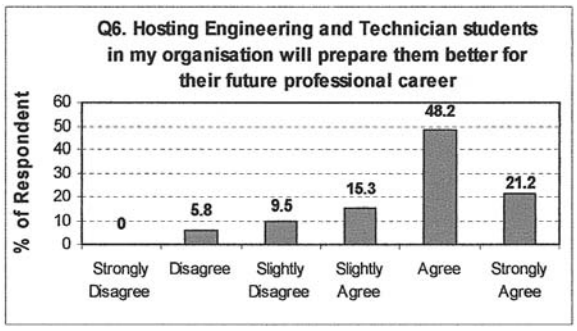

Fig. 6. Engineers' perception of hosting engineering and technician students.

sample consists of both engineers (possibly with Bachelor Degree, 20.4% of the sample) and technicians (possibly with Higher Diploma, 56.2% of the sample), this pattern of agreement more than disagreement can be expected, since those with a degree are expected to have graduated from universities as engineers whereas most of the other group have attended TVET colleges.

(Q6) Hosting engineering and technical students in organisations

In response to whether hosting engineering and technician students in organisations will prepare them better for their future professional career, most engineers and technicians (69.4%, Figure 6) agreed with this statement, only a small minority (5.8%) disagreed and 24.8% of them slightly agreed or slightly disagreed. This pattern of responses might be due to engineers' and technicians' experience and perception of the usefulness of industrial placement for acquiring employability skills. Industrial placement will help students to acquire further knowledge and skills relating to the nature of their future jobs and would become more productive and more efficient in carrying out their jobs after graduation and recruitment.

(Q7) Consultation with TVET institutions

Most respondents (56.2% of the sample) disagreed that they consult TVET institutions to solve technical problem, develop new product or to enhance performance (Figure 7), in contrast to 22.6% of them who agreed and 21.1% who either slightly disagree (10.9%) or slightly agree (10.2%). Overall, it can be said that more than two-thirds of the sample disagreed with this statement. This pattern of responses clearly reveals the poor linkage between TVET institutions and the relevant industry.

(Q8) Keeping contact with college/university after graduation

The majority of respondents (70.1% of the sample) disagreed with the statement, indicating that they have no contacts after graduation; only 10.9% of them agreed with the statement and 18.9% of them either slightly disagree (13.1%) or slightly agree (5.8%), (Figure 8). This pattern of response may also tie up somewhat with the pattern of responses to Q.7 above, and also indicates the poor linkage between TVET institutions and industry. This pattern of response, however, is not surprising in Libya, as is the case in most Arab universities and colleges, in which HEIs do not run programmes such as 'alumni' programmes, as is the case in the UK, hence, contacts stop as soon as the students graduate and nothing is known about them by their colleges and universities.

(Q9) Placement of lecturers in manufacturing organisations

The majority of respondents agreed that placing lecturers in manufacturing organisations will improve their awareness of employers' requirements; only a small minority (9.4%) disagreed and 18.9% either slightly agree (10.9%) or slightly

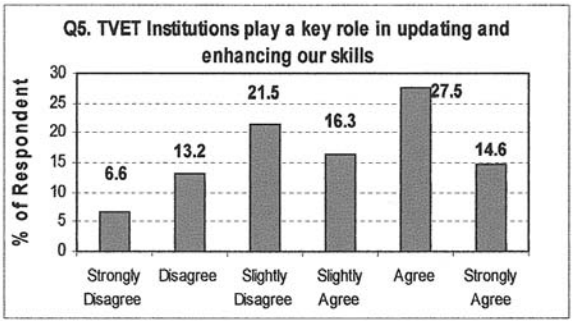

Fig. 5. Engineers' perception about the role of TVET institutions in updating their skills.

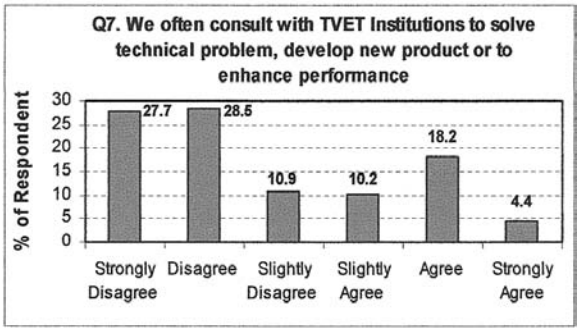

Fig. 7. Engineers' perception of consulting with TVET institutions.

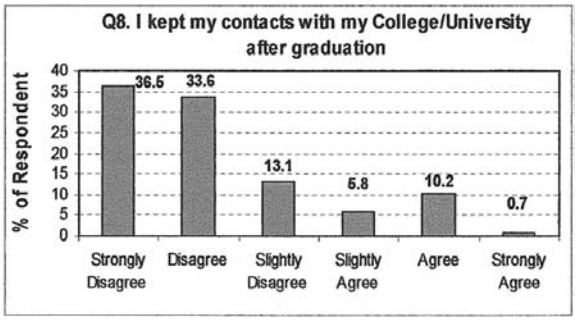

Fig. 8. Engineers' perception of their contact with TVET college/university after graduation.

disagree (8.0%), (Figure 9). Placing academic staff in manufacturing organisations will provide them with the opportunity to see at first hand what these organisations produce and what sort of engineers and technicians is required by them so that they can suggest to their institutions the programmes that would help improve the design and delivery of curricula to make them more geared to the requirements of these organisations and supply them with staff that can succeed in their jobs. This will also help strengthen the ties and linkages between HEIs and the manufacturing organisations.

(Q10) Studying for a higher qualification if an opportunity arises

Figure 9 showed that more than half of the respondents (54.7%) agreed that they will study for a higher qualification if an opportunity arises; only 16.7% of them disagreed, and 28.4% of them

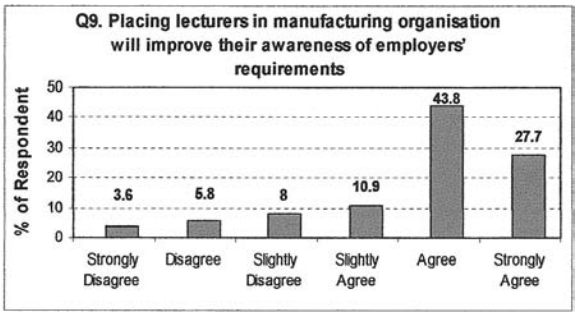

Fig. 9. Engineers' perception of placing lecturers in manufacturing organisation.

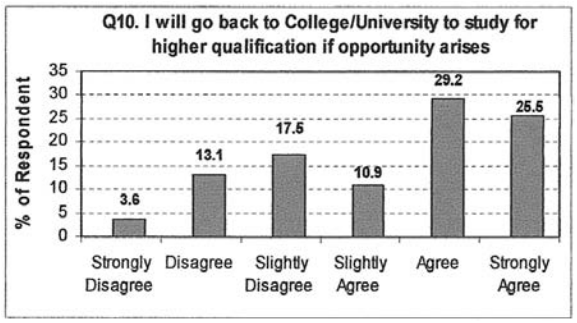

Fig. 10. Engineers' perception of studying for higher qualification if an opportunity arises.

either slightly agree (10.9%) or slightly disagree (17.5%). This pattern of responses indicates that most of the respondents want to pursue their studies if they have the chance to do so. Those agreeing with the statement are motivated individuals who want to improve and further their career by obtaining higher qualifications that help their promotion within their organisations.

6. CONCLUSIONS

Notwithstanding that the TVET institutions have increased substantially during the last ten years or so, there are still some problems in the system that affect their performance. TVET institutions, considered by the government as the main supplier of highly skilled manpower, have been unable to produce the required graduates both in quality and quantity. In fact, many of these TVET institutions suffered from the shortage in physical and human resources that are essentially required for this type of educational institutions. All these issues hampered TVET from performing their required functions in society in general and the manufacturing industry in particular.

A number of conclusions can be drawn from the study findings. With reference to students' perceptions of the partnership with industry, it can be concluded that students were dissatisfied about the linkage of courses studied to the relevant industry and this may relate to the poor quality of curricula and teachers. They also were negative in terms of lectures in presenting case studies from a relevant industry and this also may be due to the poor design of the curriculum, which is based more on theory than practical subjects. On the other hand, most students agreed that they enjoyed their field trips to industrial sites, gaining much from this experience, so that when they later become employees they will bring into work extra knowledge and competence, and thus benefit their prospective employer; it also gives them some practical insight of the job that they might have after graduation. Most of them spent some time on training in relevant industry as part of their study. This can be seen as an attempt by the educational institutions to put theory into practice.

From the engineers' and technicians' perception, it can be concluded that most of the respondents agreed that TVET institutions played a role in updating and enhancing their skills and they also expressed their agreement with the idea that placing engineering and technician students in organisations helps prepare them for future work. Nevertheless, they were negative in terms of consultation with TVET institutions to resolve technical problems; this substantiates the poor linkages between TVET institutions and the relevant industries. This poor linkage is further substantiated by the fact that most participants did not keep in touch with their educational institutions after graduation. The majority of

respondents agreed that placing lecturers in manufacturing organisations was perceived to improve their awareness of an employers' requirements. It can also be concluded that many respondents wanted to study further should an opportunity to do so became available.

Although theory-based education taught in the classroom is essential, evidence from students, engineers and technicians supports the argument that supplementing these TVET institutions with practical projects (such as training in relevant industry as part of their study and visiting industrial sites as well as hosting students in organisations), is extremely desirable. However, combining theory and practice brings a balanced approach to learning. In addition, when this is achieved, students are professionally prepared to join the realms of the fast changing, global business environment in which they will be working.

To sum up, in Libya there is still poor linkage between HEIs and manufacturing industry, and there is little coordination between the two parties in order to provide the industry with the required skilled human resources.

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APPENDIX A

Summary of Student Questionnaire Results

Characteristics		Frequencies	Percentage
Gender	Male	317	50.7
	Female	308	49.3
Age	Less than 20 years	80	12.8
	From 20 to less than 23 years	292	46.7
	From 23 to less than 26 years	206	33.0
	From 26 to less than 29 years	44	7.0
	More than 29 years	3	0.5
Academic Qualification	Bachelor	380	60.8
	Technical Diploma	245	39.2
Time of Study	Full Time	542	86.7
	Part Time	83	13.3
Father Profession	Public Sector	372	59.5
	Privet Sector	144	23.0
	unemployed	5	0.8
	Retired	104	16.6
Mother Profession	Public Sector	236	37.7
	Privet Sector	1	0.2
	unemployed	385	61.6
	Retired	4	0.5

Source: Field study conducted by the author in 2008.

APPENDIX B

Summary of Engineers and Technicians Questionnaire Results

Characteristics		Frequencies	Percentage
Nationality	Libyan	133	97.1
	Arabs	3	2.2
	African	1	0.7
Gender	Male	135	98.5
	Female	2	1.5
Age	Less than 30	4	2.9
	From 30 to less than 40 years	58	42.3
	From 40 to less than 50 years	59	43.1
	More than 50 years	16	11.7
Academic Qualification	Secondary School	32	23.4
	Technical Diploma	77	56.2
	Bachelor	28	20.4
	MSc.	0	0.0
	PhD	0	0.0
Experience of Work	Less than 5	12	8.8
	From 5 to less than 10 years	30	21.9
	From 10 to less than 15 years	33	24.1
	From 15 to less than 20 years	32	23.4
	More than 25 years	30	21.9
First job after Graduation	Yes	95	69.3
	No	42	30.7

Source: Field study conducted by the author in 2008.

APPENDIX C

Summary of Student Questionnaire Results of Partnership with Industry

No. of Question	Strongly Disagree		Disagree		Slightly Disagree		Slightly Agree		Agree		Strongly Agree	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q1	83	13.3	**198**	**31.7**	136	21.8	97	15.5	64	10.2	47	7.5
Q2	113	18.1	**158**	**25.3**	83	13.2	92	14.7	98	15.7	81	13.0
Q3	112	17.9	48	7.7	51	8.2	49	7.8	**214**	**34.2**	151	24.2
Q4	41	6.6	23	3.7	39	6.2	77	12.3	**228**	**36.5**	217	34.7

Source: Field study conducted by the author in 2008.

APPENDIX D

Summary of Engineers and Technicians Questionnaire Results of Partnership with Higher Education and Vocation Training Institute

No. of Question	Strongly Disagree		Disagree		Slightly Disagree		Slightly Agree		Agree		Strongly Agree	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q5	9	6.6	18	13.2	30	21.5	22	16.3	**38**	**27.5**	20	14.6
Q6	0.0	0.0	8	5.8	13	9.5	21	15.3	**66**	**48.2**	29	21.2
Q7	38	27.7	**39**	**28.5**	15	10.9	14	10.2	25	18.2	6	4.4
Q8	**50**	**36.5**	46	33.6	18	13.1	8	5.8	14	10.2	1	0.7
Q9	5	3.6	8	5.8	11	8.0	15	10.9	**60**	**43.8**	38	27.7
Q10	5	3.6	18	13.1	24	17.5	15	10.9	**40**	**29.2**	35	25.5

Source: Field study conducted by the author in 2008.

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