

## **5.5 Skill Standards Development**

GOTEVT has launched major efforts in establishing skill standards. It has shouldered this responsibility as the first government authority to take such action. It followed the most advanced methods and means in this process. The research team has joined GOTEVT workshop and attended demonstration to the steps taken in order to develop these skill standards. The research team highly appreciated the accomplished efforts in this regard. That is to establish scientific foundations for the development of the curricula for technical education and vocational training at GOTEVT in particular and at the Kingdom as a whole. Building upon the excellent success it has already achieved, GOTEVT should:

- Determine the frequency of each Task, Knowledge, Skills and Tools/Equipment used.
- Identify the personal aspects needed to be successful in each occupation.
- Provide greater details in their job profiles as shown in attachment 1 to 4.

### **5.5.1 The DACUM Process**

To achieve these objectives GOTEVT should expand the DACUM process to

#### **5.5.1.1 Tasks**

Identify the frequency during which the worker will use the task on a daily, weekly, monthly and occasionally basis. The highest priority task should be so noted. For example, see Attachment-1, which gives the task for Electrical Construction Worker.

#### **5.5.1.2 Tools and Equipment**

Identify the frequency, during which the worker will use the tools and equipment monthly on a daily, weekly, monthly or occasionally basis.

For an example, for Electrical Construction Worker see Attachment- (2).

#### **5.5.1.3 Knowledge Requirements**

The knowledge requirements of the Skill Standards should be ranked in order of importance. Attachment-3 provides a sample of the knowledge requirements for Electrical Construction Workers.

#### **5.5.1.4 Skill Requirements**

The skill requirements should be ranked in order of importance. Attachment 4 provides the skill requirements for Electrical Construction Worker.

#### **5.5.1.5 Academic Requirements**

The present and future workplace is more technologically advanced than in the past and will go through constant changes due to technological advancements. These conditions require workers to have a strong academic base to understand the technology and to be a life-long on-the-job learner.

The most critical academic requirement is reading. Therefore, the reading requirements for each job should be determined. GOTEVT should use the Lexile Framework to establish the reading requirements of each job.

Lexile is used to compare the reading levels of students of the material they will need to read in school, the workplace, and the society in general. A similar process is now being developed in mathematics. Lexile can be done in many languages including Arabic.

#### **5.5.1.6 Workers Basic Skills**

Success in the job is often determined by the workers basic skills, thinking skills and personal qualities. The countries that have completed Skill Standards have found that they also needed to identify more than just the technical skills, if students are to be prepared for the workplace.

GOTEVT should do a national study to determine the basic skills, thinking skills and personal qualities needed for success in the workplace.

The United States recently completed such a study. The research techniques they used should be reviewed by GOTEVT to determine if they could be appropriate for Saudi Arabia.

In the United States, the extensive research involves thousands of employers. It was conducted by the US Federal Government to identify the skills and knowledge needed by employees across all Technical and Vocational areas. This research was then analyzed and organized by a commission formed by the U.S. Secretary of Labor, entitled Secretary's Commission on Achieving Necessary Skills. Other countries have done similar but less extensive research in this area.

#### **5.5.2 The Secretary's Commission on Achieving Necessary Skills Foundation (SCANS)**

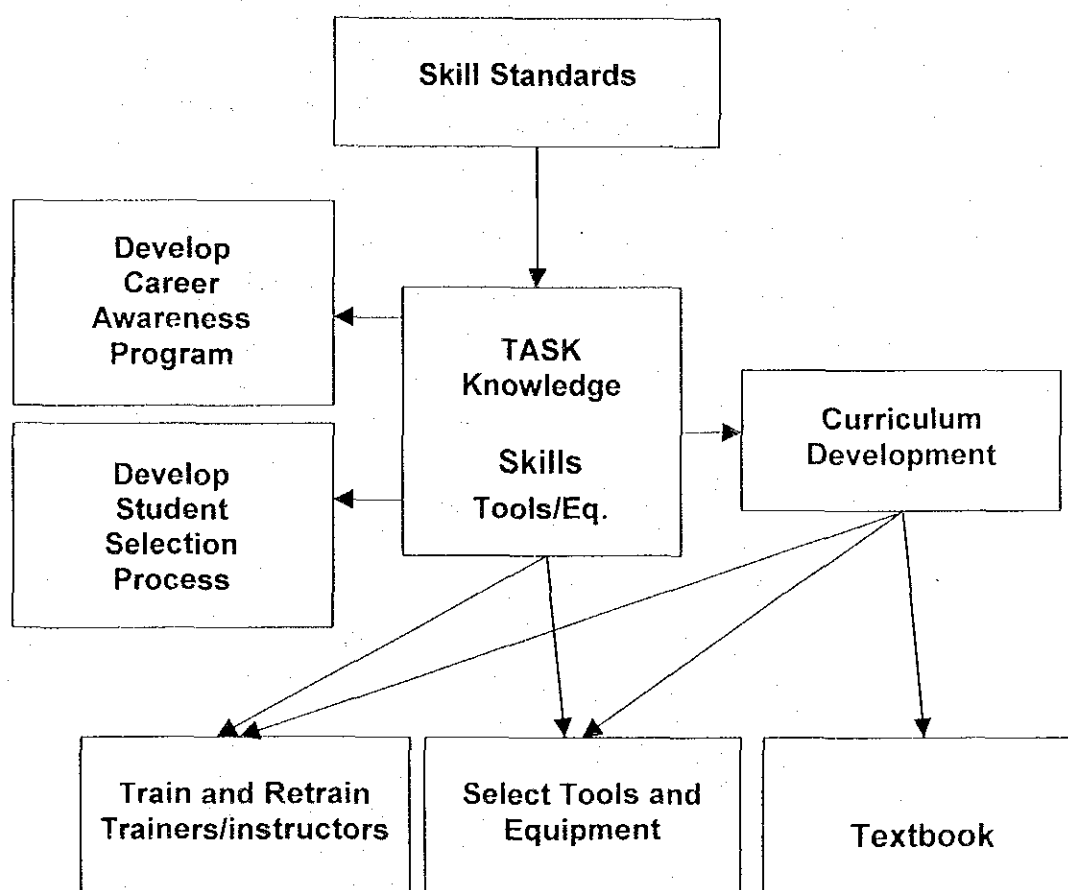
The Secretary's Commission on Achieving Necessary Skills research broke the skills and knowledge into skills/knowledge and workplace competencies. The following is a summary of this work.

A detailed description and Training Packages for each of these foundations have been developed and are being used throughout the country. GOTEVT should look at that research, its findings and outcomes to be utilized for programs and training packages development, that suits the Kingdom environment and needs.

### 5.5.3 Action Recommended

The information in the Skill Standards should be used for student selection of program, curriculum development, textbook preparation, equipping the classroom with appropriate tools and equipment, evaluation and certification of students. Figure (5-1) shows the interrelationship between each of these activities.

Figure (5-1) The Interrelationship between Activities



The following specific actions are recommended:

5.5.3.1 Student Selection Process: GOTEVT should identify the aptitudes, interest and knowledge of prospective students and compare them to the job requirements found in the Skill Standard process described in 5.5.

This data should be used to determine if the student has the aptitude and knowledge to succeed in a chosen job before enrollment into the program.

5.5.3.2 Based upon the information obtained in the Skill Standards, create a Career Awareness program about jobs to be provided to the Ministry of Education to use it for Elementary, Intermediate and Secondary School students to help them choose their career.

5.5.3.3 All jobs should be organized into clusters by occupation. GOTEVT should review its present clusters and those of other countries to determine if any modifications are appropriate at this time.

The United States just completed a major international review of how jobs are clustered and established 16 clusters for use in that country for the immediate years ahead.

The occupations in each cluster range from entry level through professional/technical management in a broad industry field. Each cluster includes the academic, technical skills and knowledge. These clusters provide a way for schools to organize course offering to students and at the same time permit Core courses to be offered to all students enrolled in any occupation within the entire cluster. The Core courses are followed by courses, which provide skills unique to a single occupation.

There are three advantages of arranging courses into core and specialized offerings. They are (1) it is more cost effective because Core course can often be given to larger classes than specialized courses, (2) students may wish to select a different occupation within their cluster after taking the Core course without loss of credit or time, and (3) student see the interrelationships between occupations in their same cluster.

The 16 clusters established by the United States are:

- **Agricultural and Natural Resources.**
- **Arts and Communications Services.**
- **Business and Administrative Services.**
- **Construction.**
- **Education and Training Services.**
- **Financial Services.**
- **Health Services.**
- **Hospitality and Tourism.**
- **Human Services.**
- **Information Technology Services.**
- **Legal And Protective Services.**
- **Manufacturing.**
- **Public Administration/Government Services.**
- **Scientific Research, Engineering And Technical Services.**
- **Transportation, Distribution and Logistics Services.**
- **Wholesales/ Retail Sales Services.**

The preparation of students in each career clusters must include (1) academic skills, (2) cluster-specific standards, and (3) broadly transferable skills. All of these aspects of the curriculum must be organized in a continuum. As students grow and develop through this continuum, they will prepare themselves for broader and higher-level opportunities.

5.5.3.4 With the Training Packages developed for each core course and specialized course, GOTEVT should then commission experts in the occupation to prepare textbooks. Textbook preparation should begin by the review of textbooks available in other countries to determine if any of them meets the need of the Saudi Arabian curriculum. If they do, GOTEVT should work with the respective publisher to obtain permission to translate them into Arabic. If permission is obtained, then translation should be assigned to the Translation Center described in section 5.6 of this report.

## 5.6 Training Methods, Materials and Medium

The most significant single change in the workplace occurring worldwide is the concept of, and commitment to, quality. GOTEVT is commended for its recognition of, and commitment to, the concept of quality through the creation of the Office of Quality Assurance.

The second most significant change in the workplace is an explosion in the use of technology.

These two changes have led to a technology intensive workplace, preparing students for sophisticated and professional production. In this work environment we must find new ways to expose the trainees to both cutting edge technologies and quality concepts used in the technical fields.

International models are emerging, they are beginning to train students who, in the past, were trained in Vocational Training Centers and Colleges of Technology. This has caused many Vocational Training Centers and Colleges of Technology, which had resisted using virtual delivery systems to change or to be forced out of business by their new competitors – private sector companies.

On the international level many other colleges and universities have moved in this direction. As many as 50% of their courses are now offered online.

GOTEVT is Saudi Arabia's Technology Leader in education. Therefore, it should take the lead in creating cost effective and highly effective use of technology systems in the education and training of its students.

The following mechanisms should be used to accomplish this objective.



### **5.6.1 Commitment to Quality**

GOTEVT should build upon its commitment to quality by requiring every program to include quality concepts into their materials and teachings.

### **5.6.2 Link the Skill Standards with Training Packages**

The Skill Standards and Training Packages recommended in section 5.4 of this report should serve as the basis of all materials developed and method used.

### **5.6.3 Proven Methodology**

Training methods, materials and medium should be based upon proven methodology.

GOTEVT should review the research on teaching methods that was done as part of the Third International Mathematics and Science Study. The research closely examined the teaching methods of trainers/instructors in the United States, Germany and Japan. The greatest contrasts were in the United States and Japan. The study showed that Japanese curriculum covered fewer topics in less time, yet students performed at higher levels than the Americans. The Japanese were able to accomplish this because of the difference in teaching methods. The methods in the United States are described as demonstration and practice. In contrast, trainers/instructors in Japan use more student application and problem solving methods. Students are given challenging problems to solve under the supervision of a trainers/instructors to whom present their solution for correction. These methods help students develop deeper levels of understanding compared to listening or watching. These problem-solving methods have great potential in improving the effectiveness of training programs.

GOTEVT should develop materials and train trainers/instructors based upon proven successful practices such as those found in the Third International Mathematics and Science Study.

#### **5.6.4 Cutting Edge Instructional Technology**

The rapid pace of change in the technologies that are found in most industrial occupations lead to a changing set of skills, procedures and techniques being used. Trainers/instructors and their students need constant updates to stay current on the needs of their industry.

It is cost prohibitive for all Colleges of Technology and Vocational Training Centers to maintain all of the cutting edge technology. Yet, students still need exposure to this technology. Therefore, GOTEVT must find new and innovative vehicles to achieve this goal.

**5.6.4.1 Develop a recommended facility and equipment plan for each Technical Education and Vocational Training Center program. This plan should list all equipment and tools that should be put in place. Equipment and tools, which are not on the recommended list, should be phased out.**

The Skill Standards described in section 5.4 should serve as the basis of the recommended list of equipment and tools.

**5.6.4.2 For equipment and tools that colleges and training centers can not obtain because they are cost prohibitive and change rapidly, GOTEVT should.**

- a) Work with business/industry to obtain multimedia demonstration of the tools/equipment.**
- b) Create virtual training system where the most cutting edge technology is provided in one location and demonstration through virtual delivery system to all Colleges and/or Training Centers offering such a program.**

**5.6.4.3 Classrooms in the Colleges of Technology and Vocational Training Centers need to be equipped with multimedia technology to enable the use of virtual delivery systems.**

5.6.4.4 A great deal of information can be taught using both the Internet and Intranet. All classrooms need to be wired and equipped to permit Internet and Intranet usage.

5.6.4.5 For trainers/instructors to effectively use the Internet and Intranet all classrooms need to be equipped with appropriate projection equipment.

## 5.7 Textbooks and Workbooks Writing and Translation

### 5.7.1 Text Books and Workbooks Writing

Textbooks and workbooks writing in the Colleges of Technology and Vocational Training Centers is one of the major problems facing technical education and vocational training in Saudi Arabia. The instructors' handouts and notes are normally the substitutes for unavailable textbooks. Some instructors use the same textbooks recommended for use at the University level. The main problem with such textbooks is that they are all theoretically oriented and lack practical exercises.

Textbooks and workbooks are the major source of learning for the trainees in the Kingdom. The fact that most of the potential trainees' communication skills in other foreign languages are poor limits their capabilities to use other sources of knowledge. Even the manipulation of the Internet needs some developed skills in computer and in the English language. Unless the potential trainees are computer literate and have a good command of communication in English, it will be difficult for them to use such advanced source of knowledge effectively.

It is imperative for GOTEVT to address the issue of writing textbooks, references and manuals for its education and training programs in Arabic language. In order to achieve successfully that goal, the following mechanism could be followed:

- 5.7.1.1 GOTEVT should allocate part of its annual budget for writing and/or translating books, references, manuals and workbooks.
- 5.7.1.2 Some generous financial incentives and rewards in the range of 50,000 – 100,000 Saudi Riyals can be paid to those who write quality books, references and manuals through writing and/or translation.
- 5.7.1.3 Books, references and manuals that are either authored or translated, shall be updated by their author(s)/translator(s) every three to five years depending upon the specific occupational cluster.
- 5.7.1.4 For updating books, references and manuals, some incentives ranging between 30,000 – 50,000 Saudi Riyals need to be paid to those authors/translators.
- 5.7.1.5 Workbooks written for trainees should include practical applications and proper illustrations.
- 5.7.1.6 Trainers/instructors manuals and solution of problems and case studies must also to be written.
- 5.7.1.7 By-laws need to be developed especially to serve GOTEVT purposes in writing and translating textbooks, references, manuals and workbooks needed for the training programs offered by the various GOTEVT training entities. The present by-laws for both writing and translating of books, references, manuals and workbooks do not fit the nature and the complexity of the technical aspects, as well as the scarcity of trainers and/or instructors who can write or translate such technical materials.

- 5.7.1.8 GOTEVT should solicit on a competitive basis proposals for writing and/or translating textbooks, references and manuals through some announcement to their trainers/instructors staff and other qualified professionals.
- 5.7.1.9 GOTEVT could cooperate, coordinate and encourage industry leaders to produce their training kits, baskets and manuals in Arabic language.

GOTEVT may lead the way in establishing a translation center that will serve initially the translation of textbooks, references and manuals for GOTEVT. However, such center could develop to be an independent entity as a cost center that will serve on the national level in the technical area.

#### 5.7.2 Translation Centers

Translation centers are useful tools in developing technologically oriented textbooks, references and manuals. It is proposed that GOTEVT should establish a Translation Center. Initially; the center can serve GOTEVT only in the translation of materials which are written in foreign languages and related to GOTEVT training programs and courses. Once the effectiveness of this center is achieved, it can be turned into a multilingual professional translation center and opens its door to serve both private and government agencies by offering its services to all of those who need and/or require professional, correct and high quality technical translation. Such a center should operate as a cost center that provides its services on fee basis.

From its inception, the center needs to coordinate with leading industries in translating their training kits, baskets and manuals. Such materials could be used further to develop textbooks, references and training manuals that will be used by GOTEVT in their training endeavors.

## 5.8 Trainers and Instructors

There is a growing international research base that shows the single most important factor in determining the quality of any educational program is the teacher. Therefore, to have highly successful Technical Education and Vocational Training Programs one must have well trained and effective teachers.

There are many models for training and retraining teachers. However, throughout the globe there has often been a great debate about their effectiveness.

In recent years a new model has emerged that has proven to be successful in many countries. The new model is built around the methodology used in vocational education for many years. That is, combine theory and practice in the actual setting you are training some one to work. In technical education and vocational training the setting in which they will work are Colleges of Technology and Vocational Training Centers. Therefore, their training should occur in that type of setting.

While all trainers/instructors need to be trained and retrained, the need is greater in Technical Education and Vocational Training than in any other field, because:

- a) Technologies and work procedures are constantly changing, thus requiring a constant updating trainers/instructors skills.
- b) With unskilled labor being replaced by technology, all workers will need higher levels of education and training. This will require Technical Education and Vocational Training Centers to educate and train a much wider range of students than in the past. This will require different teaching strategies and techniques than those used in the past.

Because of the need for more training and retraining of trainers/instructors, cost effective ways of doing this must be found.

5.8.1 GOTEVT should establish a Center for Development and Training. To cope with recent internationalization and higher technological society, the Development and Training Center will aim at bringing more Saudization policy in the 21st Century, through upgrading the quality of all teaching and training staffs on related technical education and vocational training in the Kingdom of Saudi Arabia. Assuming the Electronics Course is fully operationalized, the following is the priority order in which the remaining courses should be implemented:

- a) Machinery Technology
- b) Electricity Technology
- c) Printing Technology
- d) Construction Technology
- e) Automobile Technology
- f) Computer Technology
- g) Chemistry Technology

The trainers/instructors will be trained using the tools/equipment that they will have in their own classrooms. Through direct exposure to students in the “Development and Training Center” they will be able to develop strategies and techniques which they will use in their own classroom. Thus, the most effective and efficient system will exist.

5.8.2 The “Development and Training Center” should offer three types of training

a. Advanced Technology and Training

The new and emerging technologies should be taught to all trainers/instructors being trained and retrained.

#### **b. Multimedia Training**

Using the technology described in 5.5, trainers/Instructors will be trained in the effective use of cutting edge instructional technology.

#### **c. Communication and Cooperation**

The sharing of innovative practices being used in education and industry worldwide will be provided through conferences and presentations.

**5.8.3 The curriculum and Skills Standards development as described in sections 5.1 - 5.4 of this report should serve as the content base for all training conducted in the "Development and Training Center".**

#### **5.8.4 Trainers Selection**

Selection of trainers should be totally based on their industrial and academic experiences. The following rules should be applied in the selection process of trainers:

- Develop objective criteria for instructor/trainer selection process to include: job description, job specification and job classification.
- Prefer new hired technical instructors/trainers to have at least two years of industrial experience.
- Design an employment pre-requisite intensive training methods program to include: training methods, management of classrooms and laboratories, testing and evaluation, use of training technology and learning theory.
- Require all instructors who have not completed educational preparation programs to complete intensive training methods program.



### **5.8.5 Trainer's Development**

**5.8.5.1** The "Development and Training Center" should provide the training for all trainers/instructors.

**5.8.5.2** In addition, all retraining of staff should be done through the "Development and Training Center."

**5.8.5.3** GOTEVT should help establish a professional association in each program area. The lead specialized institution that has the responsibility for the "D & T Center" in their program area should also take the lead in the professional association.

Many international models exist for successful professional organization. The Saudi, Japanese, German and American models should all be reviewed to make use of their experiences.

**5.8.5.4** For Technical and Vocational trainers/instructors who do not have industrial experience, they should be given a 6 months sabbatical to work in the occupation they are preparing trainees for.

### 5.9 GOTEVT Capacity

The new Saudi comers to the labor market are estimated yearly by 163,460 employees from all educational and training institutions in the Kingdom. Fifty-five percent of them (89,960) will come with no skills from elementary, intermediate and secondary school graduates and dropouts entering the labor market yearly. Out of this number, 18,460 from elementary and 28,620 from intermediate graduates and dropouts, this group does not need only training, but also proper general education to be prepared for living and working, because this group comes to the lobar market with age 15 and under.

The total number of students/trainees was 27,705 students/ trainees admitted at GOTEVT Institutions in the year 1420-1421H represented only 31% of the new unskilled comers to the labor market. This shows the emergence need for GOTEVT to expand its utilization capacity of its teaching and training institutions to absorb more students/trainees of the new comers to the labor market with no skills.

The previously mentioned reform of the Colleges of Technology will increase the capacity of these colleges at least by 30%. And with the injection of the technical training program in these colleges, the capacity will go higher.

Also the reform of the Secondary Technical Institutes will raise the capacity by more than 30% by changing the system from three years program into two years program. The flexibility of the proposed program for in and out during the four sessions (two years) will raise the capacity even higher than 30%.

Likewise, the reform of the Vocational Training Centers, to be four flexible sessions instead of one and two years, will raise the capacity of these centers.

Even if GOTEVT would raised the capacity of its existing institutions by 50% it will not be able to meet the total demand of the unskilled comers to the labor market. Therefore, GOTEVT should employ the following strategies:

- a) Open its training facilities for two shifts, morning and evening shifts.
- b) Open more training facilities. After employing the said reform to GOTEVT institutions, further study is needed to identify the regions' need for opening more training facilities to meet the need for training.
- c) Coordinate with the concerned authorities to inject vocational training in general secondary schools for initial employment for certain jobs i.e. data entry personnel, front disk receptionist, telephone operators, sales personnel, filing and industrial and agricultural jobs related to the regions' need.

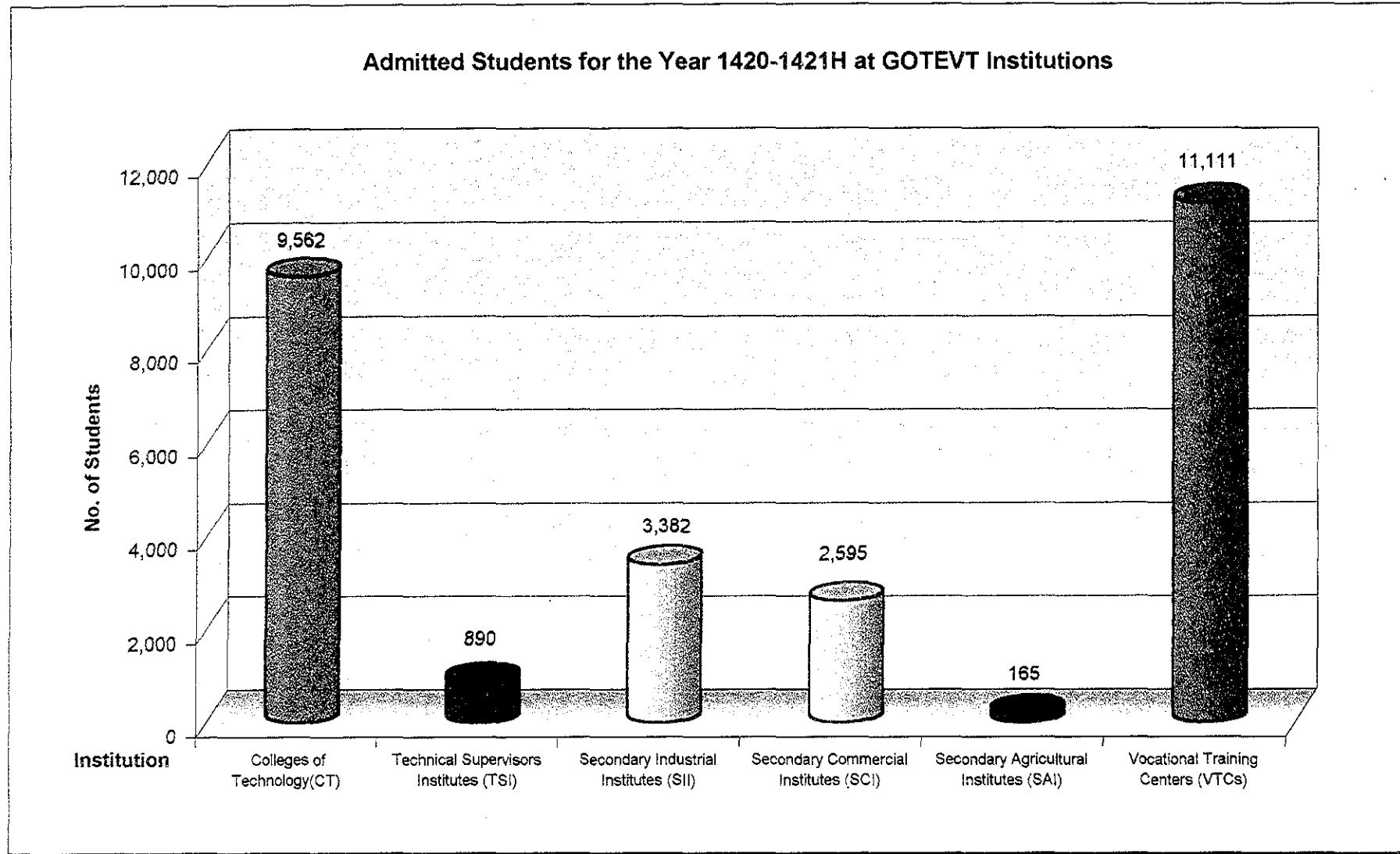
The injection of vocational training in the general secondary schools will enable the graduates of these schools to work in the said jobs if they could not or do not want to go further to their higher education. At the same, time it will reduce the burden of GOTEVT to train for these jobs which are needed badly by the labor market in large numbers.

**Table (5-6)**  
**Admitted Students for the**  
**Year 1420-1421H at GOTEVT Institutions**

S.N.	Institutions	No. Of Students
1	Colleges of Technology (CT)	9,562
2	Technical Supervisors Institutes (TSI)	890
3	Secondary Industrial Institutes (SII)	3,382
4	Secondary Commercial Institutes (SCI)	2,595
5	Secondary Agricultural Institutes (SAI)	165
6	Vocational Training Centers (VTCs)	11,111
<b>Total</b>		<b>27,705</b>

Source: GOTEVT Statistical Report 20/1421H

Figure: Table (5-6)



## **5.10 Recommended Actions**

### **5.10.1 Short- Term Actions**

**GOTEVT should take short term actions (1year) to pass the needed legislation, laws and by-laws in order to adapt the proposed reforms on the educational and training systems of the Colleges of Technology, Secondary Technical Institutes and the Vocational Training Centers.**

**Regional investigation has to be started and completed to determine the regional needs for manpower according to the economic activities. Further skill standards should be developed according to the needed manpower of regions. And the curricula to be built according should the developed skill standards.**

### **5.10.2 Medium- Term Actions**

**GOTEVT should take medium-term actions (2-3years) as follows:**

- a) Write training packages, manuals, books, workbooks, standardized inventory and aptitude tests. That is according to the set up curricula in the Colleges of Technology, Secondary Technical Institutes and Vocational Training Centers.**
- b) Train the trainers to be aware and capable to deliver the new curricula**
- c) Acquire the equipment, materials needed for the new curricula.**
- d) Make the needed changes in physical facilities for the new curricula.**

### 5.10.3 Long- Term Actions

The long- term actions to be taken by GOTEVT are:

- a) Contact the concerned authorities to inject vocational training in the general secondary schools for initial employment for certain jobs i.e. data entry personnel front desk receptionist, telephone operators, sales personnel, filing and other industrial and agricultural jobs. according to the regions' needs. This program could be set up in coordination cooperation and the usage of facilities of GOTEVT and Ministry Education. This program will reduce the burden from GOTEVT to prepare for initial employment for certain jobs that could be prepared through this program. Students who graduate from the general secondary schools with certain skills will be able to be employed if they could not or do not want to further their education.
- b) Coordinate with Ministry of Commerce, Ministry of Industry, Ministry of Labor in order to form a partnership between business, industrial and agricultural establishments and that of GOTEVT to shoulder the burden of training and practical training, both in facilities and cost.
- c) The private sector is not investing in industrial, agricultural and construction training, therefore, laws, by-laws, regulations and systems to encourage the private sector to establish industrial and agricultural training centers. This should include providing long lease land, loans and Know-how assistance. In the business-training field, the private sector is taking a lead and flourishing.

## Chapter Six

### Findings and Recommendations

#### 6.1 The Economic Structure of the Kingdom

The survey of the economic structure of the Kingdom covered the period from 1973 to 2000. The basic structural change in the Saudi Economy during that period of time was that going away from the public sector to the private sector as measured by the share of each of them in the Saudi G.D.P. In 1973 the share of the public sector in GDP was 66.4% and of the private sector was 33.6%. In 1999, the share of the public sector declined to 49.6%, while, of the private sector increased to 50.4%. Another important structural change was the movement of the Saudi Economy away from depending mostly upon only one resource (the oil) to more diversified economy.

The most important economic and social indicators of the Saudi Economy during the years 1995 – 2000, was that the population increased from 18.8 million persons in 1995 to 22.01 million persons in 2000. The labor force, which was 6.3 million persons in 1995, increased steadily to reach 7.2 million persons in 1999. GDP which was SR 478.7 billion at current prices in 1995, increased to SR 529.3 billion in 1996, and then to SR 548.4 billion in 1997. It decreased in 1998 to SR 481.2 billion but increased again to SR 535 billion in 1999 and then to SR 649.0 billion in 2000. However, in real terms (1970 = 100) GDP was SR 62.9 billion in 1995 and showed the same fluctuations as GDP at constant prices to reach SR 68.6 billion in 2000.

The annual growth rate of population in Saudi Arabia, which is rated as one of the highest in the World, is declining. In 1995, when the Kingdom population was estimated at 18.80 million persons, the annual growth rate of population was 3.6%, which declined to 3.2% in 1999 when the estimated Kingdom population was 21.33 million persons. In the year 2000 when the Kingdom population was estimated at 22.01 million persons, the growth rate of population was 3.1% per annum.

As for non-Saudi population, the annual growth rate in 1995 when their number was 5.21 million persons, was 1.7% which increased to 2.4% in 1999 when their number became 5.68 million persons, then it declined to 2.2% per annum in 2000 when their number became 5.8 million persons. The average growth rate of non-Saudi population during (1995 - 2000) was 2.1% per annum.

In 2000, the total number of schools at different levels of general education (government and private) was 11,918 schools. The total number of male students enrolled in these schools reached 2,234,195 male students, and the number of teaching posts was 172,704 posts.

The Seventh Development Plan estimated the Saudi population at 29.7 million persons in the year 2020. That means the Saudi population in 2000 (16.2 million) will increase by 83.3%, at an average annual growth rate of 3.0%. The total population in Saudi Arabia in the said year is expected to be 33.4 million persons rising from 22 million persons in 2000. This is a 51.4% increase, at an average rate of 2.1 percent per annum. The Non-Saudi population is expected to be 3.7 million persons by 2020, which is 11.1% of the total population in the Kingdom.



## 6.2 The Labor Force

According to the Seventh Development Plan, the total number of the labor force in Saudi Arabia in 1999 was around 7.2 million persons, 44.2% of them (3.18 million) are Saudis and 55.8% of them (4.02 million persons) are non-Saudis.

Most of the employees working in the private sector are non-Saudis. Out of the 6.3 million civilian employees working in 1999 in this sector 3.6 million (61.3%) were non-Saudis, whereas 2.4 million Saudis (38.7%) were working in this sector.

In 1999 the labor force was distributed according to professions. 30.5% were working in production, construction and transportation jobs, 29.8% in the services personnel and 15.6% were working in professional and technical jobs. The rest (24.1%) were engaged in agriculture and related jobs (7.7%), clerical jobs (7.4%), sales personnel jobs (7.1%) and 1.9% were in management and administration.

The highest average growth rate was in production, construction and transportation jobs (1.4%), followed by the growth rate of management and administration (1.3%), then agriculture and related jobs (0.9%) and professional and technical jobs (0.7%).

Future expectations show that most of the new jobs will also be in the private sector due to the privatization process, which is going on in the Saudi Economy. The Seventh Development Plan expects that 94.5% of the new jobs (311,000 jobs) to be realized during the five years of this plan (2000 –2005) will be in the private sector. It is also expected that during these five years the share of Saudis in the labor force will increase to 53.2%. At the end of the Seventh Development Plan (2004), the total labor force in Saudi Arabia is expected to reach 7.5 million employees.

The Seventh Development Plan continued to emphasize labor market development and Saudization. However, this plan concentrates more upon development on human resources, issues related to labor market efficiency and policies, considering the current domestic and international events; such as privatization and the recently expected membership of Saudi Arabia in the World Trade Organization (WTO). That is why this plan emphasizes the following:

- a) Increasing the participation of Saudi nationals in the labor market (Saudization of jobs).
- b) Closing the gap between the educational systems and the requirements of the labor market.
- c) Encouraging the private sector to employ more Saudis instead of non-Saudis.
- d) Provide financial resources and information needed to improve the efficiency of the labor market.
- e) Increasing the productivity of Saudi workers.

With the exception of the fourth point, all of these aspects require training and retraining to achieve. To enhance the Saudization process, Saudi entering the labor market for the first time needs to be trained to satisfy the requirements of the private sector that hesitates to employ them because they lack experience and know-how. As for closing the gap between the labor market requirements and the educational system outputs, it can only be done by training the newly entering the labor market. The training should be specific to jobs they are planning to engage. Improving the productivity of Saudis can also be achieved by training, targeted for this particular aspect.

So, all Colleges, Institutes and Training Centers have to gear their curricula to achieve each of the above mentioned aspects for manpower planning to be successful. Even the Saudi educational system has to adapt itself in order to help reducing the gap between its output and the labor market requirements and human resources development.

### **6.3 The Labor Force Projection**

The labor force projection showed that the labor force will increase from 7.24 million employees in 2000 to 8.69 million employees in 2020. Jobs will be inclined towards more professional and technical employment. Production, construction and transportation employment will increase at a faster rate than other sectors employment. The new comers to the labor market during the Seventh Plan is 817,300 employees with an estimated yearly of unskilled comers of 89,960 employees coming from elementary, intermediate and secondary school. Major efforts of training are needed. This could be attained by both expanding the utilization capacity of GOTEVT institutions and diversifying the skill levels.

### **6.4 The Present Situation of Technical Education and Vocational Training and The Proposed Reforms**

During the course of this study, the present situation of Technical Education and Vocational Training was reviewed by the study's research team. It was found that GOTEVT faces two major problems:

- a) There is extreme pressure on GOTEVT to accept more students and trainees. This is due to the increasing number of comers to the labor market with no skills.
- b) The limited capacity of GOTEVT institutions.

After extensive further review and discussion by the study research team it was found that all GOTEVT curricula (in exception of secondary commercial education) have to be reformed in duration, specialization and contents. When the duration (time) of a curriculum changes all aspects of the curriculum have to be changed, that is the specialization and contents of the courses.

The proposed reforms to GOTEVT institution are presented as follows:

### **6.5 Colleges of Technology**

The present status of the Colleges of Technology is that they are time-based. The students have to stay three years before graduation, they are also burdened with general subjects at the expense of technical subjects and practical training. There are no sets of skill standards for the graduate to meet for specific occupation. The expert opinion is to change the duration of the Colleges of Technology into two years (65 credit hours) programs rather than the present situation of three years (90 credit hours). The new programs should be built around and based on skill standards. These programs also should be related to the regional requirements of the manpower according to the economic activities of that region. The registration system has to be changed to allow the student to register for a set of courses designed for a specialization according to a set of skill standards. The student could stay only for four years and he will loose all the provided financial benefits and remuneration after two years from the date of his enrollment in the college.

To coordinate with the concerned authority in order to allow the distinguished graduates of the Technical Colleges to further their college education in similar colleges of specialization, that is based on conditions to be put by these colleges. This will allow an open education system to be put for those distinguished graduates of the Technical Colleges who want to further their higher education.

#### 6.6 The Secondary Technical Institutes

These institutes are three years system, the curricula in these Institutes (except the Secondary Commercial Institutes) are loaded with general subjects such as physics, math and chemistry, at the expense of the technical subjects and the practical training. Students' failures are caused mainly by these subjects. In addition to the fact that the curricula in these institutes are not built around skill standards. The student has to pass successfully the three years program to be graduated or he goes to the labor market with recognized level of skill for employment. Even the levels of skill the graduates have, do not justify staging three years to acquire. This time based curricula do not allow providing several levels of skilled national manpower needed by the labor market. Therefore, the secondary technical institutes have to be reformed to be Vocational Training Institutes using the facilities of the these institutes with two year programs, consisting of four sessions, graduating four levels of skilled manpower. The trainee can leave the center after any one of the four sessions being labeled at that skill level according to set skill standards. The graduates of session one will be labeled vocational level 1, and of session two as vocational level 2, and so on.

In regard to the Secondary Commercial Institutes further follow-up study is needed to assess the graduates' effectiveness on the job. That is because a major reform has been done recently to the curricula of these institutes and an evaluation has to be made for that reform.

#### **6.7 Vocational Training Centers**

The current vocational training at these centers is for one and two years. There is no flexibility to provide the labor market with diversified skill levels, which the labor market needs. The trainee under this system has to stay in the center for one or two years to be graduated. If he leaves the center before this period, he will go to the labor market with no labeled skill level. This system has to be changed into the Vocational Training Institutes system, consisting of four sessions. The trainee can leave at the end of any session and be labeled to that level. The graduates of session one will be labeled as vocational level 1, and from session two as vocational level 2 and so on.

- The trainee who is 15 years old should complete the whole program (four sessions) to be 17 years after graduation.
- The trainee who is 16 years can take only two sessions and go to the labor market by the age of 17 if he chooses to be skilled at that level of skill.
- The trainee who is 17 years old can take one session and go to the labor market if he chooses to be labeled at that level of skill.

## **6.8 Skill Standards Development**

GOTEVT has launched major efforts in establishing skill standards. It has shouldered this responsibility as the first government authority to take such action. It followed the most advanced methods and means in this process. The research team has visited GOTEVT workshop and attended demonstration to the steps taken in order to develop these skill standards. The research team highly appreciated the accomplished efforts in this regard, that is to establish scientific foundations for the development of the curricula for technical education and vocational training at GOTEVT in particular and at the Kingdom as a whole. Building upon the excellent success it has already achieved, GOTEVT should:

- Determine the frequency of each Task, Knowledge, Skills and Tools/Equipment used.
- Identify the personal aspects needed to be successful in each occupation.
- Provide greater details in their job profiles.

## **6.9 Training Methods**

It is recommended that GOTEVT commit itself to providing multimedia programs and virtual training in all Colleges of Technology and Vocational Training Centers. This will require changes in facilities, equipment and retraining of trainers/instructors to change their teaching methods. Specifically GOTEVT should take the following measure:

- a) Work with business/industry to obtain multimedia demonstration of the tools/equipment.

- b) Create virtual training system where the most cutting edge technology is provided in one location and demonstration through virtual delivery system to all Colleges and/or Training Centers offering such a program.
- c) Classrooms in the Colleges of Technology and Vocational Training Centers need to be equipped with multimedia technology to enable the use of virtual delivery systems.
- d) A great deal of information can be taught using both the Internet and Intranet. All classrooms need to be wired and equipped to permit Internet and Intranet usage.
- e) For trainers/instructors to effectively use the Internet and Intranet all classrooms need to be equipped with appropriate projection equipment.

#### **6.10 Textbooks and workbooks writing and translations**

It is imperative for GOTEVT to address the issue of writing textbooks, references and manuals for its education and training programs in Arabic language. In order to successfully achieve that goal, the following mechanism could be followed:

- a) GOTEVT should allocate part of its annual budget for writing and/or translating books, references, manuals and workbooks.
- b) Some generous financial incentives and rewards in the range of 50,000 – 100,000 Saudi Riyals can be paid to those who write quality books, references and manuals through writing and/or translation.



- c) Books, references and manuals that are either authored or translated, shall be updated by their author(s)/translator(s) every three to five years depending upon the specific occupational cluster.
- d) For updating books, references and manuals, some incentives ranging between 30,000 – 50,000 Saudi Riyals need to be paid to those authors/translators.
- e) Workbooks written for trainees should include practical applications and proper illustrations.
- f) Trainers/instructors manuals and solution of problems and case studies must also to be written.
- g) By-laws need to be developed especially to serve GOTEVT purposes in writing and translating textbooks, references, manuals and workbooks needed for the training programs offered by the various GOTEVT training entities. The present by-laws for both writing and translating of books, references, manuals and workbooks do not fit the nature and the complexity of the technical aspects, as well as the scarcity of trainers and/or instructors who can write or translate such technical materials.
- h) GOTEVT should solicit on a competitive basis proposals for writing and/or translating textbooks, references and manuals through some announcement to their trainers/instructors staff and other qualified professionals.
- i) GOTEVT should cooperate, coordinate and encourage industry leaders to produce their training kits, baskets and manuals in Arabic language.

GOTEVT may lead the way in establishing a translation center that will serve initially the translation of textbooks, references and manuals for GOTEVT. However, such center could be developed to be an independent entity as a cost center that will serve on the national level in the technical area.

#### **6.11 Trainers and Instructors**

There is a growing international research base that shows the single most important factor in determining the quality of any educational program is the trainers and instructors. Therefore, to have highly successful Technical Education and Vocational Training Programs one must have well trained and effective trainers and instructors.

While all trainers/instructors need to be trained and retrained, the need is greater in Technical Education and Vocational Training than in any other field. Therefore, it is recommended that GOTEVT take the following specific actions to train and retrain their trainers/instructors.

GOTEVT should establish a Center for Development and Training, and assuming the Electronics Course is fully operationalized, the following is the priority order in which the remaining courses should be implemented:

- a) Machinery Technology
- b) Electricity Technology
- c) Printing Technology
- d) Construction Technology
- e) Automobile Technology
- f) Computer Technology
- g) Chemistry Technology

The trainers/instructors will be trained using the tools/equipment that they will have in their own classrooms. Through direct exposure to students in the "Development and Training Center" they will be able to develop strategies and techniques which they will use in their own classrooms. Thus, a most effective and efficient system will exist.

Selection of trainers should be totally based on their industrial and academic experiences. The following rules should be applied in the selection process of trainers:

- Develop objective criteria for instructor/trainer selection process to include: job description, job specification and job classification.
- Prefer new hired technical instructors/trainers to have at least two years of industrial experience.
- Design an employment pre-requisite intensive training methods program to include: training methods, management of classrooms and laboratories, testing and evaluation, use of training technology and learning theory.
- Require all instructors who have not completed educational preparation programs to complete intensive training methods program.

GOTEVT should help establish a professional association in each program area. The lead specialized institution that has the responsibility for the "Development and Training Center" in their program area should also take the lead in the professional association.

## 6.12 GOTEVT Capacity

The new Saudi comers to the labor market are estimated yearly by 163,460 employees from all educational and training institutions in the Kingdom. Fifty-five percent of them (89,960) will come with no skills from elementary, intermediate and secondary school graduates and dropouts entering the labor market yearly. Out of this number, 18,460 from elementary and 28,620 from intermediate graduates and dropouts, this group does need not only training, but also proper general education to be prepared for living and working, because this group comes to the lobar market with age 15 and under.

The total number of students/trainees was 27,705 students/trainees admitted at GOTEVT Institutions in the year 1420-1421H represented only 31% of the new ynskilled comers to the labor market. This shows the emergence need for GOTEVT to expand its utilization capacity of its teaching and training institutions to absorb more students/trainees of the new comers to the labor market with no skills.

The previously mentioned reform of the Colleges of Technology will increase the capacity of these colleges at least by 30%. And with the injection of the technical training program in these colleges, the capacity will go higher.

Also the reform of the Secondary Technical Institutes will raise the capacity by more than 30% by changing the system from three years program into two years program. The flexibility of the proposed program for in and out during the four sessions (two years) will raise the capacity even higher than 30%.

Likewise, the reform of the Vocational Training Centers, to be four flexible sessions instead of one and two years, will raise the capacity of these centers.

Even if GOTEVT would raised the capacity of its existing institutions by 50% it will not be able to meet the total demand of the unskilled comers to the labor market. Therefore, GOTEVT should employ the following strategies:

- a) Open its training facilities for two shifts, morning and evening shifts.
- b) Open more training facilities. After employing the said reform to GOTEVT institutions, further study is needed to identify the regions' need for opening more training facilities to meet the need for training.
- c) Coordinate with the concerned authorities to inject vocational training in general secondary schools for initial employment for certain jobs i.e. data entry personnel, front disk receptionist, telephone operators, sales personnel, filing and industrial and agricultural jobs related to the regions' need.

The injection of vocational training in the general secondary schools will enable the graduates of these schools to work in the said jobs if they could not or do not want to go further to their higher education. At the same, time it will reduce the burden of GOTEVT to train for these jobs which are needed badly by the labor market in large numbers.

## **6.13 Recommended Actions**

### **6.13.1 Short-Term Actions**

GOTEVT should take short term actions (1year) to pass the needed legislation, laws and by-laws in order to adapt the proposed reforms on the educational and training systems of the Colleges of Technology, Secondary Technical Institutes and the Vocational Training Centers.

Regional investigation has to be started and completed to determine the regional needs for manpower according to the economic activities. Further skill standards should be developed according to the needed manpower of regions. And the curricula to be built according should the developed skill standards.

### **6.13.2 Medium- Term Actions**

GOTEVT should take medium-term actions (2-3years) as follows:

- a) Write training packages, manuals, books, workbooks, standardized inventory and aptitude tests. That is according to the set up curricula in the Colleges of Technology and Vocational Training Institutes.
- b) Train the trainers to be aware and capable to deliver the new curricula
- c) Acquire the equipment, materials needed for the new curricula.
- d) Make the needed changes in physical facilities for the new curricula.

### 6.13.3 Long- Term Actions

The long- term actions to be taken by GOTEVT are:

- a) Contact the concerned authorities to inject vocational training in the general secondary schools for initial employment for certain jobs i.e. data entry personnel, front disk receptionist, telephone operators, sales personnel, filing and other industrial and agricultural jobs according to the regions' needs. This program could be set up in coordination cooperation and the usage of facilities of GOTEVT and Ministry Education. This program will reduce the burden from GOTEVT to prepare for initial employment for certain jobs. Students who graduate from the general secondary schools with certain skills will to be employed if they could not or do not want to further their education.
- b) Coordinate with Ministry of Commerce, Ministry of Industry Electricity, Ministry of Labor and Social Affairs and Ministry of Agriculture and Water in order to form a partnership between business, industrial and agricultural establishments and that of GOTEVT to shoulder the burden of training and practical training, both in facilities and cost.
- c) Establish laws, by-laws, regulations and systems to encourage the private sector to establish industrial and agricultural training centers. This should include providing long lease land, loans and know-how assistance. In the business education and training field, the private sector is taking a lead and flourishing.

**Attachment-1**  
**Skills and knowledge**  
**For Electrical Construction Worker**  
**(National Skills Standards Board)**

The skills and knowledge for Electrical Construction Worker (Inside, Building Construction) were obtained through a compilation of information gathered through a review of the literature, on-site observation, expert panel input, and job analysis survey of job incumbents and training personnel.

**Duties**

The duties of an Electrical Construction Worker are listed below. Tasks are described as daily, weekly, monthly, or occasionally, based upon the responses of a majority of Electrical Construction Worker in the position. Tasks that were rated highly important have an asterisk.

**I. Planning and Initiating Project**

**Daily:** When planning a new project, an Electrical Construction Worker must study blueprints and specifications, \* materials, supplies and equipment must be ordered to complete the job.\*

**Weekly:** Materials and supplies must be loaded, hauled and unloaded at the job site. The Electrical Construction Worker establishes work areas and assembles tools and equipment. The Electrical Construction Worker coordinates tool requirements with the contractor. The job schedule must also be coordinated with other crafts.\*

**Monthly:** At times the Electrical Construction Worker establishes timetables and/ or progress charts for completion of the work. It may be necessary to obtain clearances, such as for digging.\*

**Occasionally:** An Electrical Construction Worker may be required to set up a temporary construction trailer or other control center at the site.



## **II. Establishing Temporary Power During Construction**

**Monthly:** An Electrical Construction Worker may need to maintain and repair a temporary power system as needed during construction.

**Occasionally:** An Electrical Construction Worker may determine temporary power requirements by consulting with other crafts. Temporary power may need to be coordinated with a local power company. The Electrical Construction Worker may need to establish a temporary power source, set up temporary panel(s), and run lines for temporary power and lighting throughout the project.

## **III. Establishing Grounding System**

**Monthly:** An Electrical Construction Worker positions the ground conductors and welds or mechanically connects them.

**Occasionally:** An Electrical Construction Worker studies blueprints to determine a plan for the grounding system.\* The location of the grounding conductors and connections must be laid out first.\* Next, the Electrical Construction Worker digs trenches or coordinates trench excavation performed by others. After the electrodes or rods are established, the system can be tested.\* If the system is working properly, the area is backfilled with dirt.

## **IV. Installing Services to Buildings and Other Structures**

**Monthly:** An Electrical Construction Worker installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be secured, reinforced and the inside swabbed, if needed. The location of the conduit stub ups may be measured and determined. \*

**Occasionally:** An Electrical Construction Worker studies blueprints to determine where power will feed from the substation.\* The local power company may need to be contacted to determine the location of feeders.\* The location of other electrical conduit or other structures, such as water mains, must be determined before deciding where to locate the new feeders.\* The Electrical Construction Worker may need to compute the size of service entrance conductors needed for the required services.\*

When the locations of the feeders are determined, the Electrical Construction Worker lays out trenches for the conduit. The Electrical Construction Worker digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The Electrical Construction Worker then backfill the trench with dirt or other materials. An overhead service entrance may also be established.

#### **V. Establishing Power Distribution Within Project**

**Monthly:** An Electrical Construction Worker makes all necessary terminations.\*

**Occasionally:** An Electrical Construction Worker studies blueprints to determine the location of the high voltage room or electrical closet.\* The transformer equipment, including transformers, breakers and switching gear, may need to be moved into the building. Once in the building, the equipment must be moved from the entry points to the correct position. The Electrical Construction Worker may install the main service panel, including the circuit breakers and switching gear, and hipots the high voltage cables.\* If needed, a buss duct may be placed to carry power.

#### **VI. Planning and Installing Raceway System**

**Monthly:** An Electrical Construction Worker must calculate the necessary bends, saddles and offsets needed to install conduit. The Electrical Construction Worker must determine where to place the junction boxes.\* He or she measures where the conduit should land and the amount of conduit needed to complete the run. In preparing the conduit for use, the Electrical Construction Worker must cut it to fit, file or ream the inside to make it smooth, and then bend it and thread it.\* After it is prepared, the conduit must then be transported to the correct location. The conduit can be connected by screwing pieces together or using couplings. The Electrical Construction Worker plumbs and levels the conduit and places the junction boxes where planned. Making holes if needed and making sure the box is plumb and level.

**Weekly:** An Electrical Construction Worker studies blueprints to determine the placement of the conduit.\* The number of wires/cables that can be put into each conduit must be determine.\* Sometimes holes must be cut in metal to run the conduit. Hangars and support for conduit must sometimes be built. When completed, the cable may be marked and/or tagged for voltage and other identification.

**Monthly:** An Electrical Construction Worker may be required to cut holes in concrete to run conduit.

**Occasionally:** An Electrical Construction Worker may sometimes paint the conduit for identification.

## **VII. Installing New Wiring and Repairing Old Wiring**

**Weekly:** An Electrical Construction Worker assembles all materials needed at the location for pulling the cable. Small conduit can be fished with fish tape or other means. A string line must first be pulled through the conduit followed by a rope. The length of wire needed is measured with the pull line or a calibrated tape. The Electrical Construction Worker cuts the length of wire or cable needed.\* The rope is pulled through the conduit connected to a pull line. The Electrical Construction Worker sets up wire/cable reels for pulling. The wire is connected to the pull line and lubricated to facilitate pulling. The Electrical Construction Worker pulls the wire by hand. After the wire is pulled, the necessary terminations are made and the wire is spliced if needed.\* An Electrical Construction Worker may examine the test existing wire.

Monthly: An Electrical Construction Worker may be required to pull wire with a pulling machine. An Electrical Construction Worker may swab the inside of large conduit to remove dirt or debris before pulling the wire.

#### VIII. Providing Power and Controls to Motors, HVAC, and Other Equipment

Monthly: An Electrical Construction Worker studies blueprints to determine where motors and equipment will be placed and establishes the layout. \* The power feed and control-wiring system must be installed. The motor must be connected to run on the appropriate voltages. \* The Electrical Construction Worker may need to change the direction of rotation of electrical motors. After installation, the Electrical Construction Worker may need to change the direction of rotation of electrical motors. After installation, the Electrical Construction Worker tests the functioning of the motors.

Occasionally: An Electrical Construction Worker must read the technical manuals describing the functioning of each piece of equipment in order to determine the proper connection. \* A control panel may need to be constructed or installed for the motors and equipment. The Electrical Construction Worker may set the motors in place and secure it with bolts or other equipment. Various starters may be installed, including starters for DC motors, magnetic starters, potential-type motor starters, and reduced voltage starters. The RCW may locate and connect pilot/control devices for the motor and/or electronic variable speed motor controls. The motor must be connected to run at the appropriate speed.\*

## **IX. Installing Receptacles, Lighting Systems, and Fixtures**

**Weekly:** An Electrical Construction Worker studies blueprints to identify circuits. \* At times it may be necessary to work around other systems, such as air conditioning, to find a path for lighting and receptacle wiring. The Electrical Construction Worker locates raceways for carrying the wire. The Electrical Construction Worker measures the wire needed for various runs. He or she then establishes homeruns from the panel box. The Electrical Construction Worker must run raceway, cable or wire from the junction box to the lighting fixture. The Electrical Construction Worker makes electrical connections in the fixtures and receptacles and places jams in the lighting fixture. Switches must be located to control lighting and receptacles must be installed for power outlets. Plates and covers must be placed on the receptacles and switches. The Electrical Construction Worker may attach a lighting fixture to the ceiling. After installation, the Electrical Construction Worker tests the lights and receptacles.

**Monthly:** An Electrical Construction Worker may need to balance loads on various circuits. \* Other crafts may need to be consulted before making the final determination of locations for lighting systems. The Electrical Construction Worker may need to establish panel boxes. When installing fixtures, it may be necessary to cut openings in the ceiling.

**Occasionally:** An Electrical Construction Worker may make a panel directory. After the work is completed, the Electrical Construction Worker may complete "as built" drawings.

## **X. Troubleshooting and Repairing Electrical Systems**

**Monthly:** An Electrical Construction Worker determines which lighting fixture or piece of equipment is not working properly. \* Possible reasons for failure can be reviewed. He or she may discuss the problem with an operator or other witnesses. The problem is analyzed through testing.\* The faulty unit or component is localized. The Electrical Construction Worker then replaces or repairs the faulty component.

Occasionally: The faulty section of a circuit may be identified using the split-half method.

## **XI. Installing and Repairing Traffic Signals, Outdoor Lighting, and Outdoor Power Feeders**

Occasionally: When installing outdoor lighting and signals, an Electrical Construction Worker must follow blueprints that show where equipment is to be located. \* The Electrical Construction Worker lays out trenches for the conduit. The Electrical Construction Worker digs trenches or coordinates trench excavation performed by others. The trenches must be graded and leveled. The Electrical Construction Worker installs raceway supports and lays the conduit in the trenches with spacers, if needed. The conduit must be secured, reinforced and inside swabbed, if needed. The Electrical Construction Worker lays direct burial cable without the conduit. A hole must be dug for the lighting base. The Electrical Construction Worker may form the base for the pole, including assembly of reinforcing steel. The base way then is poured with concrete and finished, it may be backfilled and compacted.

The Electrical Construction Worker may assemble poles and other hardware, as well as the lighting fixture or traffic light. After the fixture is attached to the pole, the pole can be set and leveled. The pole is set and then attached with anchor bolts. Cable can be pulled and terminated. Direct burial cable may need to be spliced.

For traffic signals, the Electrical Construction Worker must cut sensor loops in the asphalt and place sensors in the road. Control cabinets must be established and the traffic or signal controller programmed. After installation is completed, power can be connected and tested.

## **XII. Installing Fire Alarm System**

Occasionally: An Electrical Construction Worker studies blueprints to determine fire alarm device locations\* and reads the manual on the specific fire alarm system being installed. \* The detection and signal devices must be placed and a connection made between these devices and the controller. The Electrical Construction Worker installs raceways and control panels for the alarm system, as well as manual pull alarm stations. Programmable alarm systems must also be programmed according to requirements. \* After installation, the system must be tested to be sure that it is working properly. \* The Electrical Construction Worker then can schedule a test and inspection by state and/or local authorities.

## **XIII. Supervising Electrical Construction Worker and Apprentices**

Daily: On a daily basis, an Electrical Construction Worker assigns tasks to personnel, including apprentices. \* The Electrical Construction Worker may need to teach an apprentice a new task by explaining or demonstrating.\* The apprentice's performance must then be observed and feedback given.\*

## **XIV. Installing Instrumentation and Process Control Systems, Including Energy Management System**

When installing an instrumentation or process control system, an Electrical Construction Worker studies the blueprints and schematic diagrams for the system\* and reads the manual on the system.\* The layout for various devices must be determined, including temperature, lighting, pressure-sensitive, level, flow measuring, or chemical sensors.\* The Electrical Construction Worker locates the instrumentation devices and builds raceways to hold the cables. Control panels must be installed, as well as conductors and tubing. The Electrical Construction Worker makes the electrical or pneumatic connections between the sensor and the controller.

A central processing unit may need to be established. The Electrical Construction Worker programs the computer or other programmable control devices.\* The instruments must be tested and calibrated.\* The Electrical Construction Worker performs a loop check and prepares loop sheets documenting the system as installed.

#### **XV. Erecting and Assembling Power Generation Equipment**

An Electrical Construction Worker may install batteries to provide a backup power source. The batteries may be installed in series or in parallel. At times, the Electrical Construction Worker may be required to assemble a generator. The generator may then be installed and tested to be sure it is operating properly.\*

#### **XVI. Installing Security Systems**

An Electrical Construction Worker studies blueprints to determine the locations of security system components\* and reads the manual on the specific security system being installed.\* A control panel for the system must be located and installed. The initiating and detection devices must be positioned. The Electrical Construction Worker establishes raceways and wires for the alarm system. Video equipment, including cameras and other monitors, may be positioned. Doors and windows may be wired to detect opening and closing. Motion detectors may also be placed and connected. The Electrical Construction Worker programs and tests the security codes for the system. The system is tested and adjusted to be sure it is operating as planned. He or she distributes access codes to the appropriate persons. Building personnel may need to be trained on the use of the system.



## **XVII. Installing Maintaining and Repairing Lighting Protection System**

An Electrical Construction Worker determines the layout of the lightning protection system. Rods are driven and tested, if required. Conductors are established between the grounded structures, and the rods are bolted or welded together. Cable can be laid on the roof deck and fastened to the deck and walls. Any exposed cable is sealed by the Electrical Construction Worker. Rods or points with brackets are mounted and connected to the grounding cable.

## **XVIII. Installing and Repairing Telephone and Data System**

An Electrical Construction Worker may need to design a new telephone or data system while keeping the old system operational. The Electrical Construction Worker works with the customer to determine their requirements. The installation manual for a computer control systems may need to be read and applied. The Electrical Construction Worker may need to consult with the company about the specific application being used. The telephone, data control panel, and/or distribution frame may be built by the Electrical Construction Worker. Cable trays may need to be positioned to hold the wires. The Electrical Construction Worker may install jacks, patch panes, telephone, data system hubs and devices, and telephone and data switch plates consistent with system design. Fiber optic, coaxial and/or twisted pair cable can be pulled to individual workstations throughout the building. The wires can be terminated in the control panel or central processing unit. Fiber optic cable may need to be spliced and terminated.\* Wires are tagged to match the intended system. The Electrical Construction Worker programs the telephone control computer to handle the phone service as planned. The completed system can be tested using special test equipment. The fiber optic cable may be tested and certified.\* If errors appear upon testing, the system must be adjusted and then retested.\*

## Attachment-2

### Use of Tools

Electrical Construction Worker uses a broad array of tools. Using the same procedure as above, we classified tools by frequency in the same manner.

Daily: Hand Tools: level, pliers, needle, nose pliers, slip joint pliers, hammer, wire cutters, screwdriver, fishtape, measuring tape, hacksaw, wire stripper, hand bender, ladder, knife, ruler, wrench, knock-out sets.

Power assisted tools: hand drill

Meters: voltmeter

Weekly: Hand Tools: file, punch, socket set, allen wrench, keyhole saw, pumping tool, hand drill, hand reamer, awl, vise, tap and dies.

Power assisted tools: electric screw gun, electric roto hammer drill, hydraulic header, power cutting and threading machine.

Meters: ammeter

Monthly: Hand Tools: plumb bob, fuse puller, lamps, pipe wrench, torque wrench, architect scale, handsaw, wood chisel, shovel, hoist cum-along

Power assisted tools: electric saber saw, wire tugger

Heavy equipment: electric lift.

Occasionally: Hand tools: transit block and tackle, adapter cables, caliper, tamp tool.

Power assisted tools: soldering iron, drill press, gas-operated auger, air hammer, concrete coring machine, roto stripper, water pump, fiber optic fusion splicer.

Meters: oscilloscope, wattmeter, optical power meter, MEGGER, dielectric test set to hipot cable, dynamometer, optical time domain reflectometer (OTFR).

Heavy equipment: trencher, bucket truck, crane, power borer, derrick, auger, dozer, backhoe, caterpillar.

## **Attachment-3**

### **Importance Rankings of Knowledge**

Knowledges are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The knowledges are therefore, separated into three divisions: extremely to very important, very to moderately important and moderately to somewhat important.

#### **Extremely to Very Important**

Knowledge of National Electrical Code: Knowledge of blueprints, including symbols used; knowledge of specific job safety rules; knowledge of hazardous materials; knowledge of first aid; knowledge of OSHA requirements; knowledge of the principles of grounding; knowledge of different conduit bends (saddle, offset, etc.); knowledge of connections to be made for various transformers; knowledge of Ohm's Law and related formulas; knowledge of proper over current protection for transformers; knowledge of which wire/cable to use in different circumstances; knowledge of delta and wye transformer connections; knowledge of which materials are good conductors and insulators; knowledge of direct and alternating current; knowledge of how to calculate degrees when bending conduit; knowledge of building specifications; knowledge of how to perform an emergency rescue; knowledge of parallel circuits; knowledge of magnetic motor controls; knowledge of circuit breaker ratings; knowledge of transformer ratings; knowledge of fuse ratings; knowledge of combination circuits; knowledge of series circuits; knowledge of how to care for tools and equipment; knowledge of solid state motor controls; knowledge of fire alarm systems; knowledge of how fuses operate; knowledge of switching procedures; knowledge of ladder logic diagrams; knowledge of how AC motors operate; knowledge of the ratings of different types of switch gear;

knowledge of resistance and its effects; knowledge of the properties of high-voltage cable; knowledge of appropriate hand signals to use with ground crew or equipment operators; knowledge of how a circuit breaker works; and knowledge of inductance.

#### Very to Moderately Important

Knowledge of how generators alternators work; knowledge of algebra; knowledge of how DC motors operate; knowledge of how a surge protector or lighting protector works; knowledge of the functions of capacitors; knowledge of which knot to tie in different circumstances; knowledge of power factor correction; knowledge of other crafts' scope of work and responsibilities; knowledge of the functions of batteries in providing electrical power; knowledge of programmable logic controllers; knowledge of how transformers are constructed; knowledge of how to erect a pulley system for lifting heavy objects; knowledge of how a voltage regulator works; knowledge of photo-electric sensors; knowledge of security systems; knowledge of sine waves generated by electrical power; knowledge of process controllers and control loops; knowledge of geometry; knowledge of air conditioning and environmental control systems; knowledge of harmonic distortion of voltage/current; knowledge of the spacing of ducts needed in a duct bank; knowledge of the lifting capacity of various riggings for block and tackles; knowledge of temperature sensors; knowledge of pressure sensitive sensors; knowledge of the properties of fiber optic cable; knowledge of level sensors; knowledge of the effect of soil conditions on underground cable; knowledge of the properties of twisted pair cable; knowledge of proper depth and width needed when digging holes for supporting poles; knowledge of the properties of coaxial cable; knowledge of telephone and data system; knowledge of the properties and use of insulating oils in transformers; knowledge of semiconductor electronics; knowledge of chemical sensors; and knowledge of trigonometry.

### Moderately to Somewhat Important

Knowledge of what makes a wooden pole unsafe to climb; Knowledge of local area networks; Knowledge of strains and loads on a pole or tower that could require a guy wire; Knowledge of the properties of metal, concrete or fiberglass poles and towers; knowledge of which ties to use with which types of insulators; knowledge of how many and which kinds of insulators to use on power lines; knowledge of orthographic and isometric sketching; knowledge of different types of guy anchors; knowledge of different types of pole and crossarm designs; knowledge of the properties of different kinds of wooden pole; and knowledge of tree growth and pruning techniques.

Importance Ranking of Skills: Skills are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The skills are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

Extremely to Moderately Important: Skill at reading a wire table to determine conductor size required; Skill at performing CPR; Skill at terminating aluminum or copper cable; Skill at terminating high voltage cable; Skill at terminating coaxial cable; Skill at splicing fiber optic cable; Skill at terminating fiber optic cable; Skill at programming programmable logic controllers; Skill at operating a bucket truck; and Skill at soldering.

Moderately to Somewhat Important: Skill at driving a truck; Skill at splicing rope; Skill at welding; Skill at coiling and storing rope; Skill at shoveling or raking wet concrete; and Skill at operating a crane.

## **Attachment-4**

### **Importance Ranking of Abilities**

Abilities are listed in descending order of importance. However, the difference in importance of any two rankings in some cases is minimal. The abilities are therefore separated into three divisions: extremely to very important, very to moderately important; and moderately to somewhat important.

**Extremely to Very Important:** Ability to be self-motivated, responsible; and dependable without close supervision; Ability to understand verbal instructions and warnings; Ability to work smoothly with others as a team to complete a task; Ability to add, subtract, multiply and divide and use formulas; ability to remain calm in an emergency situation; ability to communicate orally with others; ability to maintain good relations with others in a work setting; ability to hear warning signals; ability to plan and organize tasks to meet deadlines; ability to read complex technical documents, including manual on electrical equipment, code documents and safety rules; ability to discriminate between colors; ability to develop alternative solutions to a problem and choose the best alternative; ability to maintain balance and perform construction tasks while on a ladder, platform, pole or tower; ability to supervise and monitor the work of others; ability to understand how an electrical or mechanical system works (such as security system or fire alarm system); ability to use hands and fingers to manipulate small wires and objects; ability to communicate in writing with others; ability to read and understand graphs, charts and diagrams; ability to work with both hands (such as tying knots); ability to operate tow-handed power equipment; ability to lift objects up to 50 pounds; and ability to reach and stretch to position equipment and fixture while maintaining balance.

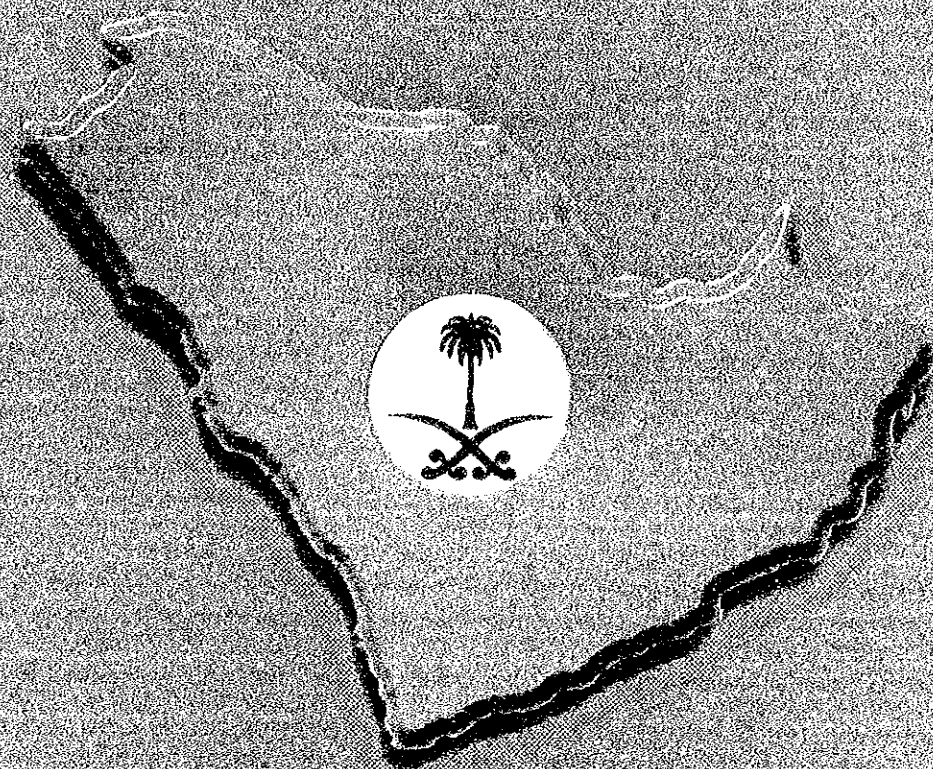
### Very to Moderately Important

Ability to coordinate body movements when using tools or equipment; ability to carry objects up to 50 pounds for short distances; ability to work at heights; ability to climb ladders and poles up to 25 feet; ability to traverse irregular surfaces while maintaining balance; ability to work in extreme hot and cold temperature conditions; ability to work outdoors in extreme weather conditions, including heat, cold and precipitation; ability to picture the way a construction project will appear before it is finished; ability to perform physical tasks all day without becoming overly tired; ability to work in a noisy environment; ability to lift objects above 50 pounds; ability to push or pull heavy objects into position; ability to work at depths, such as in trenches, manholes or deep vertical shafts; ability to apply muscular force quickly to objects and equipment (such as starting a hand saw); ability to carry objects above 50 pounds for short distances; ability to bend or twist the body into unusual positions while working; and ability to use muscular strength to raise and lower heavy objects on a line or pulley.

### Moderately to Somewhat Important

Ability to walk long distance, sometimes over irregular terrain; ability to work in unusual positions for long periods of time; ability to resist torque of motor while maintaining balance; ability to climb ladders and poles from 26 to 100 feet; ability to bend to get over or under objects while working on top a pole or tower; and ability to climb poles above 100 feet.





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