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Technical and Vocational Education and Technology Transfer: Departments of Electrical Engineering at the Public Authority for Applied Education and Training, PAAE&T, Kuwait, As A case Study

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Abstract. The role of technology transfer in technical and vocational education is significant since lecturers, trainers, and students can obtain the updated knowledge, skills, and attitudes that are currently being practice by local and international business and industries. Technology transfer can indeed close the gap between what is being learned and practice in technical and vocational institutions and the world of work. However, the success technology transfer in technical and vocational education perspective would depend entirely on the quality of management. It is their responsibility, when signing an agreement with internal or external providers of technology, to include calluses that enable academic staff in related specialty to interact positively and freely with the supplier on technology. In other terms, ensuring no clear or hidden restriction imposed by the supplier of technology to acquire the know-how and know-why that are embedded in the agreement. In this paper, **I present some of the empirical results and observations which describe the interactions between the supplier of technology (Electrical Engineering System) and the recipient of the technology (PAAE&T) in the field of technology transfer.** In other word, whether the PAAE&T have taken the opportunity, while building its new headquarter, in the transfer of technology from the supplier of electrical engineering system to its academic staff in its various **Electrical Engineering Academic Departments** at the PAAE&T colleges and institutions. The paper argues that, for effective and efficient transfer of technology, the recipient (PAAE&T) must ensure that the agreement with the supplier of Electrical Engineering System must include calluses that would allow the PAAE&T academic staff in its various **Electrical Engineering Academic Departments** in its various colleges and institutions to acquire the technology embedded in the agreement. The paper concludes that the transfer of technology and the building of a local scientific and technical infrastructure must be viewed by Kuwaiti decision-makers as a complementary to one another. Thus, reducing, to great extent, the level of dependence on expatriate, particularly in essential sector of the economy.

Keywords. Technology Transfer, developing Indigenous Manpower, **Electrical Engineering System**, Kuwait

1. Introduction:

Recently, attention have been heavily devoted to technical and vocational education to respond to the urgent need of skilled and semi-skilled manpower in industries and business. It

is perceived as the gate to reducing unemployment rate, lower poverty rate, reducing crimes, enhancing health care, improving the standard of education and graduates, increasing wages, overcoming technical problems, encouraging youth employment, and overall enhancing the standard of living. Technical and vocational education viewed as a “dual system”. It allows the transfer of knowledge, skills, and attitudes through a proper and efficient technology transfer channel that would have a positive implication on the standard of teaching and learning, workshops and laboratories, research and development, students’ assessment schemes, curriculum development, and eventually producing a high quality of graduates. The “dual system” would permit a significant integration of apprentices into the workforce arena that reduces the level of youth unemployment and increase skills acquisition that are compatible with industrial and business requirements. Interaction between technical and vocational education is highly noted in related literature. (Interreg Europe, 2020, European Commission, 2017, Gerard and Min, 2019). Interaction between both parties (technical and vocational education institutions and industries and business) would have a positive and tangible outcome on various activities such as: joint research, consulting, problem solving, curriculum development, industrial training programs, intellectual properties, and licensing. The fruitful of such collaboration would be reflected on the quality of technical and vocational graduates as well as the academic staff. In the other hand, from industrial perspective, industry would receive skilled and semi-skilled manpower, solve existing production problems, achieving profits, modifying products, reduce production cost, and contribute, to great extent, to overall country manpower plan. The role of teachers in technical and vocational education is clearly marked in related literature. Technical and vocational education teachers obtained both pedagogical and industry and business knowledge to prepare young students and adults for the career market. (OECD, 2021). Teachers’ qualifications and commitments play a vital role in the success of technical and vocational education. (Fiftyana, 2018, Serafini, 2018) However, the success of teachers in achieving their course objectives would strongly depend on the level of management support in facilitating the transmission from school-to -work. The management skills that are highly needed to succeeds in technical and vocational education would include innovation, marketing skills, negotiation skills, and ability to close the gap between technical and vocational education and the recipients of graduates. Indeed, it is a management responsibility to ensure a suitable learning environment for both students and teachers to maintain high standard of technical and vocational graduates. (Ruiz-Valenzuela, 2017) The global rapid change in science and technology have profound repercussions on the education system in various countries while focusing on reforming technical and vocational education system to respond to the demand of the application of advance production technology in industries and business. The implication of the constant changes in science and technology forced the leaders and the management of technical and vocational education to be more dynamic and vigilant to new labour market requirements. However, the success of technical and vocational education would depend, to great extent, on the quality of the leaders and the management in achieving overall technical and vocational objectives. In technical and vocational perspective, it is purely a top management responsibility to assign a qualified dean for managing a certain college or institute that he/she able to, thoroughly and practically, absorb the concept of technical and vocational education and its purposes. The fact is managing a technical and vocational education institutions is completely different from managing a formal education institution (e.g., formal colleges and universities). It is the main responsibility of those who manage technical and vocational institution to effectively and efficiently meet the requirements of industries and business. The fact is that technical and vocational institutional leaders play a vital role in ensuring that students as well as teachers have access to high-quality of teaching and learning that can have a

remarkable positive impact on student's skills (OECD, 2021), and has a significant contribution on student's achievement and teachers working conditions. (Ruiz-Valenzuela, et. al., 2017) Technology is considered as a significant precondition for improving productivity, attaining, industrial advancement, and enhancing export growth. (Lakhera, 2016) In industries and business perspective, technology would encourage a team work approach in a more effective and efficient manner and solve employees' differences and conflicts. In industrial point of view, technology would improve productivity, enhancing workers knowledge and skills, improving industrial image, lower cost rate, lower unemployment rate particularly between youth, increasing profits, enhancing creativity, and enhancing society living standard. Technology can increase quality of product throughout all stages of the manufacturing process, improving the efficiency of the plant, reduction of material wastages, and enhancing effective communications. (The Manufacturer, 2017) Technology transfer is currently used as a blanket term to cover a wide range of activities, which include information flow from laboratory throughout various appropriate departments in a firm for different applications. These include production, marketing and diffusion of innovation, the shift of knowledge, from production-oriented to application-oriented institutions, the application of a technology for a purpose other than the one for which it was designed, the license or sale of technology produced in the industrialized nations to others, and generally speaking, the process by which science and technology are diffused throughout human activity. Therefrom, there is no tightly-controlled definition of the concept of technology transfer in the related literature. However, some commonality can be identified when the transfer is viewed as an innovation process by which an idea, practice, or objective is applied for the first time by an individual or institution. The process of technology transfer can be described in the simplest of terms as encompassing three stages. First, the technology must have a source. Second, the technology must be produced or manufactured. Finally, the technology must be applied or used in some social or economically profitable way, such as in the production of water, electricity., gas, medical, or oil technology. In all these cases, a movement or transfer must occur from one function to another, from industry to industry, or from nation to nation.

The gulf states governments acknowledge the need to equipped indigenous manpower with the necessary knowledge, skills and attitude to enable them to work in local industries and business. The dependence rate on expatriates in the gulf states is high particularly in essential sector of their economy (e.g., oil and electricity and eater, health sector, infrastructure). The United Arab Emirates (UAE), like most of the gulf states relay heavily on expatriates' manpower (nearly 90% of the population), in the Kingdom of Saudi Arabia, it is estimated that expat constitute over 10 million out of its population, and half in Oman and Bahrain. (Sabena, 2020) The current population of Kuwait in 2021 is 4,328,550 a 1.36% increase from 2020. Expatriates account for about 70% of Kuwaiti population, among which 1.1 million Arab expatriates and 1.4 million Asian expatriates. (World Population Review, 2021) Due to the outbreak of Covid 19 pandemic and its impact on jobs declines, the employment level would expect to fall by at least 13%. For instance, in the Kingdom of Saudi Arabia, 1.2 million expats forecast to leave this year, and Kuwait planning to reduce expat numbers to 30% from its current 70% of the total populace. (Christopher, 2020) Decision makers in the gulf states have realized the urgent need to enhance indigenous capabilities by setting a plan to promote the availability of indigenous capabilities able to adapt, maintain, and manage the imported technology apply in local industries and business. Therefore, attention was diverted into technical and vocational education to respond to the need on skilled and semi-skilled national manpower particularly in essential sectors of the gulf states economy (e.g., oil and electricity and water, health sector, infrastructure). However, the success of technical and vocational education would depend on

the management sincere willingness to tackle any ethical misconduct that might have a negative implication not only on learning and teaching but also on the reputation of the institution. Kuwait, a developing country, has high economic potential as a result of its oil resources. It has also been undergoing a process of technology transfer for about the last decades. Kuwaiti key figures have also appreciated the curial role of technical and vocational institutions in providing essential sectors of the economy with the skilled and semi-skilled indigenous manpower in order to reduce, to great extent, the dependence on expatriates. The Kuwaiti government has forged the Public Authority for Applied Education and Training, PAAE&T, in 1982 to respond to the urgent of essential sectors of the economy from semi and skilled indigenous manpower. The PAAE&T aims include interaction with major institutions in the labour market, training national manpower, joint research with local industries, and linking programs to society's needs and requirements. In another word, the Kuwaiti government attention is not only to prepare students to the world of work but also to closing the gap between technical and vocational institutions and local industries. The PAAE&T has five colleges and eight training centers. The aim of the PAAE&T is to **“to provide the national technical workforce that meets the requirements of social and economic development in terms of quantity and quality... and taking into account the general indicators of the needs of the labor market and the variables it carries that govern the labor market needs of graduates of applied colleges and training institutes”**. (The PAAE&T Website) The research examines whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at Electrical Engineering Academic Departments in its various colleges and institutions. (Al-Anbah New Paper, 2021) In other word, whether the management of the PAAE&T has allowed and encouraged those who are specialized in Electrical Engineering Academic Departments in its various colleges and institutions to gain the know-how and know-why embedded in imported technology. It hopes that the results of this research would guide the management of the PAAE&T in setting and implementing a proper and efficient plan that ensure the technology transfer agreement include clauses that enable its staff in its **Electrical Engineering Academic Departments** in its various colleges and institutions to interact positively with the supplier of technology. Indeed, this would have a significant implication of the reduction of the level of dependance on expatriates and the enhancement of local capabilities in the area of Electrical Engineering System.

2. Research Objectives:

The research examines whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at Electrical Engineering Academic Departments in its various colleges and institutions. In other word, whether the management of the PAAE&T has allowed and encouraged those who are specialized in electrical engineering system in its academic departments in its various colleges and institutions to gain the know-how and know-why embedded in imported technology. It hopes that the results of this research would guide the management of the PAAE&T in setting and implementing a proper and efficient plan that ensure the technology transfer agreement include clauses that enable its staff in its **Electrical Engineering Academic Departments** in its various colleges and institutions to interact positively with the supplier of technology. This would have a significant contribution in the

reduction of the level of Kuwait's dependence on expatriates, particularly in essential sector of the economy.

4. Materials and Methods

4.1 Design

This research consisted of a descriptive survey designed to identify and examine the type of interactions between the Public Authority for Applied Education and Training, PAAE&T, and the supplier of technology (Electrical Engineering System) while building its new headquarter. The PAAE&T has five colleges and eight training centers. They are namely: Faculty of Basic Education, Faculty of Business Studies, **College of Technological Studies, College of Health Sciences, College of Nursing, the Institute of Nursing, Higher Institute of Communications and Navigations, the Higher Institute of Energy, the Sabah Al-Salem Industrial Institute, and Shuwaikh Industrial Institute, Structural Training Institute, Vocational Training Institute, and Higher Institute of Administrative Services. The research examines whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at computers and communications academic departments in its various colleges and institutions. In other word, whether the management of the PAAE&T has allowed and encouraged those who are specialized in electrical engineering system in its Electrical Engineering Academic Departments in its various colleges and institutions to gain the know-how and know-why embedded in imported technology.**

4.2 Sample

The research encompassed interviews with (3) heads and senior engineers representing the supplier of technology (Electrical Engineering System). The recipient of the Electrical Engineering System is the PAAE&T which has five colleges and eight training centers. They are namely: Faculty of Basic Education, Faculty of Business Studies, **College of Technological Studies, College of Health Sciences, College of Nursing, the Institute of Nursing, Higher Institute of Communications and Navigations, the Higher Institute of Energy, the Sabah Al-Salem Industrial Institute, and Shuwaikh Industrial Institute, Structural Training Institute, Vocational Training Institute, and Higher Institute of Administrative Services. The aim is to examines whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at Electrical Engineering Departments in its various colleges and institutions. In other word, whether the management of the PAAE&T has allowed and encouraged those who are specialized in electrical engineering system in its Electrical Engineering Academic Departments in various colleges and institutions to gain the know-how and know-why embedded in imported technology.**

4.3 Instrumentation

The target population for this research consists of interviews with (3) heads and senior engineers representing the supplier of technology (Electrical Engineering System). The recipient of the Electrical and Engineering System is the PAAE&T, which has five colleges and eight training centers. They are namely: Faculty of Basic Education, Faculty of Business Studies, **College of Technological Studies, College of Health Sciences, College of Nursing, the Institute of Nursing, Higher Institute of Communications and Navigations, the Higher**

Institute of Energy, the Sabah Al-Salem Industrial Institute, and Shuwaikh Industrial Institute, Structural Training Institute, Vocational Training Institute, and Higher Institute of Administrative Services.

4.4 Statistics and Parameters

The statistics pertain to the sample. The parameters pertain to an entire population.

4.5 The research parameters/sample are as follows:

a) Interviews were conducted with (3) heads and senior engineers representing the supplier of technology (Electrical Engineering Systems).

b) **The selected colleges and institutions at the PAAE&T are:** Faculty of Basic Education,

Faculty of Business Studies, **College of Technological Studies, College of Health Sciences, College of Nursing, the Institute of Nursing, Higher Institute of Communications and Navigations, the Higher Institute of Energy, the Sabah Al-Salem Industrial Institute, and Shuwaikh Industrial Institute, Structural Training Institute, Vocational Training Institute, and Higher Institute of Administrative Services.**

5. Research Findings:

5.1 The Characteristic of the Research Sample.

Interviews were conducted with (3) heads and senior engineers representing the supplier of technology (Electrical Engineering System). **The aim is to examine whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at Electrical Engineering Academic Departments in its various colleges and institutions. In other words, whether the management of the PAAE&T has allowed and encouraged those who are specialized in Electrical Engineering Academic Departments in its various colleges and institutions to gain the know-how and know-why embedded in imported technology.**

5.2 Measuring the level of collaboration between the supplier of technology (Electrical Engineering System and the recipient (PAAE&T).

The symbiotic interaction between technical and vocational education institutions and industries and business is highly stressed in related literature. (GLD, 2021, OECD, 2018, Australian Government Productivity Commission, 2021, Triki, 2008, Yorke and Knight, 2019) The contribution of a strong linkage between technical and vocational education and local industries and business is manifest itself in the contribution of employers in the academic program design, implementation and assessment (GLD, 2021), reducing rate of unemployment, particularly in youth unemployment (Simone, 2020), enhancing students' knowledge and skills (The World Bank, 2017), and strengthening teachers' competencies and personality (OECD, 2021, Gabriela, 2016), reviewing and monitoring curriculum to respond to industrial needs (Bohmann, 2007), forming proper policy and strategy for future manpower needs analysis (Khawla 2011, Ministry of Education and Sports, 2019), enhancing and upgrading the learning process to be compatible with industrial requirements (OECD, 2021), maintaining a strong partnership for ensuring a continuing future successful collaboration (Florinda, 2021), and strengthening academic-industry collaboration which is essential for the purpose of research and development, innovation and building human capital for economic growth. (Jummu, et.al., 2021). An effort has been exerted to interview (3) heads and senior engineers representing the

supplier of technology (Electrical Engineering System). **The aim is to examines whether the management of the PAAE&T has invested the opportunity in building its head quarter building which cost around 63 million Kuwait Dinar equal to approximately 190 million USA dollars, in the transfer of technology to its academic staff at Electrical Engineering Academic Departments in its various colleges and institutions. In other word, whether the management of the PAAE&T has allowed and encouraged those who are specialized in electrical engineering system in its Electrical Engineering Academic Departments in its various colleges and institutions to gain the know-how and know-why embedded in imported technology.** The types of collaboration between both parties are revealed below.

Identifying whether the academic staff at the Electrical Engineering Departments at the PAAE&T in its various colleges and institutions received the know-how and know-how embedded in the Electrical Engineering Technology.

<i>Have the Academic at the Electrical Engineering Academic Departments in its various College and Institutions at the PAAE&T Participated with the Supplier of Electrical Engineering Technology in the Installing of the followings Tasks:</i>	Yes	No
Designing and Installing Electrical Design & Drafting System.		X
Designing and Fitting Pumping System.		X
Designing and Installing Building Automation System.		X
Designing and Installing Building & Management System (BMS).		X
Conducting Heat Load Calculation.		X
Designing and Installing Air Design System.		X
Designing and Fitting Ventilation System.		X
Designing and Installing Static Pressure System.		X
Designing and Installing Hydraulic System.		X
Designing and Installing HVAC Softwares.		X
Conducting Pumping Calculation.		X
Designing and Installing Electrical Inter Layout.		X
Designing and Installing Electrical External layout.		X
Designing and Installing Fire Fighting System.		X
Designing and Installing Rain Harvesting System.		X
Installing Safety & Health System.		X
Installing Sewage Treatments System.		X
Installing Electrical Distribution System.		X
Installing Security Entrance and Evacuation System.		X
Installing Security System.		X
Installing Total Connected System.		X
Installing Single Line Designing (SLD).		X
R Installing aw Power Layout.		X
Installing A/C layout.		X
Installing, Fxing & Maintaining Air Condition System.		X
Installing and Maintaining Heat System.		X
Installing and Maintaining, Lightning System.		X
Installing and Maintaining Elevator System.		X
Installing and Maintaining Emergency System.		X

Installing and Maintaining Security System.		X
Installing and Maintaining Sensor System.		X
Installing and Maintaining Electrical Distribution BoardsSystem.		X
Installing and Maintaining main Electrical Board System.		X
Installing and Maintaining Electrical Wiring System.		X
Detecting Electrical Fault System.		X
Fixing Electrical fault System		X
Installing Duplex Multi Mode Fiber Optic Patch Panel.		X
Installing Augmented Intelligent Patch panel with Built in Cable management for Horizontal cabling		X

The above (approximate responds) is obtained from (3) Senior Engineers who are in charge of Electrical Engineering System.

The role of electricity in our daily life is highly noted and appreciated by all who live on this planet. Hospital needs electricity for life sporting machines especially during the outbreaks of Covid-19 pandemic, conducting surgery, performing MRI and Scan, operation sensitive lab testing and analyzing machines, performing detail surgery, and operating heart supporting machines and devices. In industries point of view, electricity is essential for production process, materials handling, sorting products and raw materials, assembling process, painting and polishing, performing maintenance job, operating whole manufacturing production system, and activation of security cameras and CCTV. In our homes, operating refrigerators and ice coolers, TV's and computers, water system, air conditioning system, ventilation system, heating system, and washing and drying of clothes. The demand for the consumption of energy and water is increasing due to the fast growing of population, changing of consumer consumption habit, the high rate of commercial and industrial usage. In fact, the majority of water in the electricity sector is consumed for generating electricity (about 88%), especially for cooling processes at thermal power station plants, with thermal power station plants accounting for about 70% of the today's international installed power station plant capacity. (OECD, 2018) According to U.S. Energy Information Administration (2021), USA is considered the second major country in the production of electricity and generates around 4327 terawatts per hour of energy. The outbreak and spread of Covid-19 pandemic in the world have creating a critical and challenging situation for decision makers to ensure the continuing supply of electricity and water, particular to the health sector. "The most important challenge for electricity companies in the region has been to ensure the continuity of services despite the effects of the pandemic. This isn't an industry in which people can work from home; you have to operate 24/7 to ensure electricity reaches homes reliably," says Ariel Yépez, chief of the Energy Division at the Inter-American Development Bank. (IDB, 2021) In Kuwait as in many gulf states (e.g., United Arab Emirates, Bahrain, Oman), The shortage of skilled and semi-skilled is highly noted in essential sector of the economy. Expatriate form approximately 88.5% of the United Arab Emirates population, 70% in Kuwait, and 53% in Bahrain. The Kuwaiti government, as in other gulf states, has realized the importance of enhancing indigenous capabilities, particularly in essential sectors of the country's economy (e.g., oil, electricity and water). As a result, the Kuwaiti Government has established the Public Authority for Applied Education and Training, PAAE&T, which has five colleges and eight training centers.

The interaction between the supplier of internet works and communications technology and the recipient of technology (the academic staff working at the computer and communications department at various colleges and institutions at the PAAE&T), would facilitate the transfer of know-how and know-why among academic staff. Regrettably, no

concrete evidence has been allocated to confirm the participation of academic staff at the Electricity Engineering Academic Departments at various colleges and institutions at the PAAE&T in all stages relating to the designing, selecting, installing, testing, and evaluation all aspects (electricity machines and devices, wiring, cabling, switches, sockets, emergency entrance and exists, elevators, air condition system, heating system, water and electricity saving system) related to the implementation of a professional electricity engineering system at the PAAE&T new headquarter building. Bearing in mind, that the new PAA&T headquarter building which cost approximately **63 million Kuwait Dinar equal to approximately 190 million USA dollars. It is worth mentioning that, the only department who was actively involved with the supplier of electricity engineering system technology was the Engineering Department at the PAAE&T who play a vital role in determining the electricity engineering specification system. However, their role was to design, supervise, assess, follow, and ensure whether the supplier of electricity engineering system provided and install all the items and specifications that are listed in the agreement. When asked if the Engineering Department staff at the PAAE&T involve in the installation of all items related to the agreements such as: participating in fitting wires, cable, cabins, devices, monitors, switches, and others. The answer was unclear. However, the supplier of electricity engineering system confirms to the author that they have conducting a training program to the Engineering Department staff at the PAAE&T. An attempt was made possible to investigate whether the PAAE&T included a transfer of technology calluses in the agreement that would allow the transfer of know-how and know-why to their academic staff at its various Electricity Engineering Academic Departments in its various colleges and institutions, and the answer was unfortunately “not specified”.**

6. Summary & Conclusions

Technology transfer is considered as the crucial ingredient in technical and vocational education. It is through which, students, academic staff, and the head of the technical and vocational education institutions can obtain the updated knowledge, skills, and attitudes that are in urgent need of industries and business. Technology transfer must be a significant and affective para of technical and vocational education most listed objectives. The exclusion of technology transfer from the objectives of technical and vocational education would have a negative implication of the quality of teaching and learning, curriculum development, research and development, workshops and laboratories, students' assessment scheme, apprenticeship, and overall affecting the quality of graduates. It is purely a management responsibility to truly and sincerely involve academic staff as well as students in the future projects so that both (students, lecturers and trainers) can gain the actual knowledge and skills. Technical and vocational education cannot work in a “vacuum” anymore. Kuwait needs indigenous skilled and semi-skilled manpower able to manage, adapt, maintained, and assess the imported technology to suit local work environment. In addition to, reducing the level of dependence on expatriate in essential sectors of the country's economy. However, the findings of this research indicated without doubt, that the academic staff and students at the Electrical Engineering Academic Department were not involve with the supplier of Electrical Engineering System to the new headquarter building of the PAAE&T nor acquiring the embedded technology in the assigned agreement which cost millions of USA dollars. The only department who was involved in technology transfer is the Engineering Department at the PAAE&T head office. The management of the PAAE&T must perceive the future projects with the internal or external supplier of technology as a real “workshop” or a real “training program” that would allow both academic staff in its Academic Electrical Engineering Departments in its various colleges and

institutions as well as students to acquire the real “knowledge, skills, and attitude”. Technical and vocational education cannot perform within a “black box”. The management of the PAAE&T must “break” the “black box” and adapt a new philosophy that enable all part in the education and training system to activity interact with the supplier of technology. Through which, Kuwait would move a forward step into the process of reducing dependence on expatriate, otherwise, the country would continue to rely on expatriate for years ahead.

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