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# Exploring the Factors Affecting the ICT Technology Transfer Process: An Empirical Study in Libya

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**Abstract**

The purpose of this work is to develop a model that describes the international technology transfer (ITT) process of information and communication technology (ICT) from developed to developing countries. This paper is a part of an ongoing study aiming to develop a technology transfer model examining the embracing of a foreign advanced technology to the ICT companies as well as ICT-based SME's projects in Libya. The past relevant TT models are reviewed with the intention of exploring and sort out the most ITT influential factors. The questionnaire that conducted recently in the TT process in the Libyan ICT industry was utilized to verify the model. Major statistical techniques are applied to analyze the survey received data. To establish reliable measures for the factors and sub-factors under investigation as well as to reduce their numbers, Exploratory Factor Analysis (EFA) was implemented. Furthermore, the goal behind using (EFA) is to combine these sub factors according to a theoretical conceptual. Several sub factors and items were dropped and the model's factors were regrouped as TT government support initiatives, transferor characteristics, transferee characteristics, TT environment, and learning centers. In addition, the TT outcome (achievements) factors, are identified and refined, some items were discarded. The outcome of this analysis is the verified model for ITT in ICT projects, which includes a number of refined enabling and achievements variables.

**Keywords:** International Technology Transfer ITT, Information and Communication Technology ICT, Exploratory Factor Analysis EFA, modelling

## 1. Introduction

Technology has become one of the essential elements of social and economic development in several newly industrialized countries. Technology is involving knowledge, equipment, and documents can assist firms to upgrade their performance (Wang & Chien 2007). Over the past decade, information and communication technology (ICT) has helped create the most rapidly growing industry sectors, driven efficiency in government and business operations. It has been evidenced by developments from different rising countries that the ICT as a sector can contribute vastly to the national GDP of nations. Furthermore, ICT can efficiently assist international economic integration, narrow the digital divide, and improve living standards. One of the means to impart the advanced technologies to the developing countries is through the Technology transfer process (TT). Several researchers in different industrial areas investigated this process. They were acknowledged that the ITT process is a multifaceted process that is influenced by several factors (Kedia, 1988; Madu, 1989; Cusumano, 1994). The interaction between these factors can affect the level of effectiveness of the TT process. A surveyed literature on relevant TT models showed that none of these researches was dedicated to studying the TT process in the area of ICT-based SME's projects.

Libya, like most developing nations, recognizes the importance of Information and Communication Technology as a catalyst for sustainable socio-economic development. The aim of this study is to develop and empirically tested model that describes the TT process of embracing of foreign advanced technology by ICT companies and ICT-based SME projects in Libya. The variables that extracted and modified from the past investigated studies are classified as factors and sub-factors in a conceptual ICT industry context model. Calantone (1990), Simkoko (1992), Kumar (1999), Lin and Berg (2001), Malik (2002), Wang (2004), Steenhuis (2005), Waroonkun (2008), Mohamed (2010), and khabiri (2012),These relevant models investigation and comparison are presented in details in previous study of Hassan, A. (2015). The TT model is specially designed to addressing the technology transfer from developed countries to the Libyan ICT industry. Moreover, the results of the evaluation study of the TT process influential and outcome factors in the Libyan ICT industry were gathered from a survey that recently conducted.

*1.1 ITT Model Based on Entrepreneur ICT Based SME*

The proposed model defines all the important factors that influence the effectiveness of the ITT process and its results (achievements). These relevant factors have been adapted from the examined leading studies into the TT phenomenon with the objective to develop a model that explains the TT process in ICT industry and related SME's projects. Through a process of categorizing variables taken from the previous studies and conceptualizing their relationship with one another in the ICT industry context a number of factors were identified. The identified factors were classified as enabling factors and TT outcome (TT Achievement) factor.

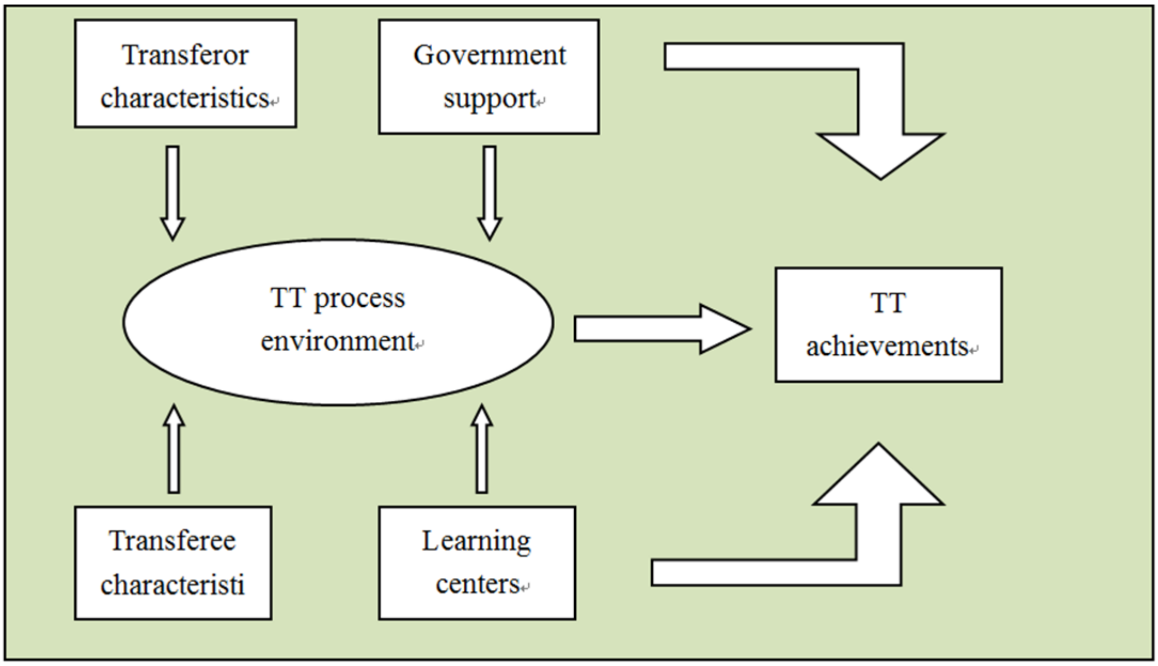


Figure 1. ITT Model for ICT based SME

The developed conceptual model is presented in Figure 1 that illustrates how the developed enabling factors interact to create value (TT achievements) for the host ICT sector. The TT government support initiatives, Transferor characteristics, Transferee characteristics, TT environment, and learning centers are at the left and middle of the model as exogenous constructs, while the outcome factor, TT achievements, has presented as an endogenous construct at the right of the model. The arrows represent the hypothesized causal paths between each enabling and the outcome factor.

The Government support factor was concerned with the degree to which the government's policies and enforcement practices encourage TT to occur. While the learning centers are obviously an important and influential factor in the TT to the developing countries; this factor related to host country-learning capability.

The transferor's characteristic factor is concerned with the transferor's readiness and ability to provide the appropriate technology to the recipient, and transferor's previous experience level in ITT process. On the other hand, the transferee characteristics factor is a significant factor that affects ITT process. Absorptive capacity, prior knowledge, and experience, learning intent, and technological ability identified by the literature as an influential recipient characteristics. The TT process (TT environment) factor explores the effect of technology characteristics, transfer mode, and the relationships between transferor and transferee. The management of TT program and the role of the agent middleman in the TT process are also investigated. The model factors and sub factors listed in Table 1.

Table 1. Model factors and sub factors

| code | factor | sub factor |
|---|---|---|
| A2. | TT government support initiatives | |
| A2.1 | | Government policy (regulations governing the ICT industry). |
| A2.2 | | Availability of adequate infrastructure. |
| A2.3 | | Government Support. |
| A2.**4** | | Parent companies encouragement to the skilled workers. |
| A2.5 | | ICT Parent companies supporting to ICT SMEs. |
| B2 | Learning centers and ICT entrepreneurs Learning Capability | |
| B2.1 | | The educational systems, training programs, and R&D centers. |
| B2.2 | | ICT entrepreneurial training and development. |
| B2.3 | | ICT Technology based incubator. |
| B2.4 | | Involvement of ICT industry in university programs. |
| C 2 | Transferor's characteristic | |
| C2.1 | | Transferor's willingness to implement TT initiatives and cooperate with local workers. |
| C2.2 | | Transferor's knowledge base and skills. |
| C2.3 | | Transferor's ability to transfer technology. |
| C2.4 | | Transferor's degree of previous international experience. |
| D2 | Transferee's characteristic | |
| D2.1 | | Technology absorption capabilities of the recipient firms. |
| D2.2 | | The transferee's degree of experience in ITT process. |
| D2.3 | | The shortage of a skilled workforce with the recipient firm. |
| D2.4 | | The transferee's motivation to learn new technologies. |
| E2 | TT process. ( TT environment ) | |
| E2.1 | | Complexity level of the technology to be transferred. |
| E2.2 | | The mode of technology transfer. |
| E2.3 | | The formally planned and well managed TT agreements. |
| E2.4 | | The relationship between the transferor and transferee |
| E2.5 | | The cultural traits of the both parties. |
| E2.6 | | The entrepreneurial agent middleman. |

In this study, the performance of and interrelationship between, the above-mentioned TT factors contributes to the achievements of the host ICT sector. The model defines four main areas (sub-factors) where potential benefits derived from international TT initiatives: economic development, project (firm) performance, knowledge and technological capability improvement, and development and survives of ICT technology SME's. The model output factor (TT achievement) explained through four sub-factors and these four sub-factors detailed into several items as shown in Table 2.

Table 2. Achievements factors and sub-factors

| code | Factor | Sub factor |
|---|---|---|
| A4 | Economic development | |
| A4.1 | | Host country industrialization and economic development. |
| A4.2 | | Local ICT firm's competitiveness in national markets. |
| A4.3 | | The financial performance of local ICT firms. |
| A4.4 | | Utilization of Libyan natural and human resources. |
| A4.5 | | Diversification into new products or markets. |
| B4 | Project (firm) performance | |
| B4.1 | | Libyan ICT industry overall long-term performance. |
| B4.2 | | Efficiency, services cost and service quality of the host project. |
| B4.3 | | Quality standards in Libyan ICT firms. |
| B4.4 | | Mastering the new technology, by the Libyan ICT firms. |
| B4.5 | | Functional performance of the products, products cost and quality. |
| C4 | knowledge and technological capability improvement | |
| C4.1 | | The ICT local firm’s technological capabilities and skills base. |
| C4.2 | | The recipient's ability to operate, learn new external technologies. |
| C4.3 | | Local workers' development. |
| C4.4 | | Libyan ICT sector working practices over the long term. |
| D4 | development and survive of ICT technology SME's | |
| D4.1 | | Develop and surviving of ICT SMEs. |
| D4.2 | | Reducing cost of production, maintain consistency in quality, improve productivity for ICT SMEs. |
| D4.3 | | The ability to employ a significant amount of the labor. |
| D4.4 | | Mastering new process techniques by ICT SMEs. |
| D4.5 | | The emergence of ICT entrepreneurs in a small scale enterprise. |
| D4.6 | | Increasing technological capabilities and capacities for ICT SMEs. |

## 2. Method

In this research, a quantitative cross-sectional survey was utilized to investigate the TT process in Libyan ICT industry. The questionnaire was sent to the respondents on the second quarter of the year of 2015. Data collection for this study is specifically collected from Libyan ICT industry employees. A questionnaire survey carried out on the sample targeting ICT companies' employees who have involved in TT processes in Libyan ICT industry includes experts, engineers, administrators, technicians, and project supervisors. In total, a 268 questionnaire was distributed and 162 were returned representing a response rate of 60.5 % percent.

The descriptive and inferential statistical techniques are utilized to analyze the quantitative received data to address the research questions. The Statistical Package for the Social Sciences (SPSS 21) software was implemented. The analysis included descriptive statistic to create a respondent profile. Prior to implementation of exploratory factor analysis (EFA), several assumptions were tested: the univariate normality of all factors, anti-image correlation matrix, the factorability, and factors reliability. The Exploratory Factor analysis was performed separately (single factor solution). Such decision to perform a single factor solution was because all the independent variables in this study emerged from a different theoretical background. Therefore, a single factor solution deemed to be appropriate, rather than implementing EFA on all the independent variables simultaneously. The outcome of this analysis is the confirmed model for international TT in ICT projects, which includes a number of refined enabling and achievements variables.

### *2.1 Research Strategy*

The research strategy designed in a way that guarantees accurate execution for each phase of the process. Many forms of research techniques and data collection methods are available to fulfill the desired objectives of this type of study. This research utilizes a quantitative cross-sectional survey to investigate the TT process in Libyan ICT industry; questionnaire surveys can collect a large number of responses within a relatively short time. A questionnaire survey carried out on the sample targeting ICT companies' employees who have involved in TT processes in Libyan ICT industry. Thus, respondents from Libya's ICT industry considered the appropriate respondents to evaluate the adoptions and the importance of factors affecting the TT process and the outcomes that can gain.

### *2.2 Sampling Procedure*

This study uses the non-probability sampling method instead of using probability sampling. The choice of the non-probability sampling method is due to the absence of the sampling frame of the expert's workforce in Libya who meets the criteria of this study (list of experts who had worked on projects with the association of foreign partners companies are not available). In such case, a convenient sampling method, as part of the non-probability sampling technique, deemed to be an appropriate choice. Since the experts will have the freedom to whether to participate or not in this study.

#### 2.2.1 Sampling Criteria

There are certain criteria of respondent's inclusion that should be followed. Initially, the respondents should possess an adequate number of experiences and have executed a minimum of one TT process projects with foreign companies. Indeed, the sub-factors in the survey are technical. Therefore, it requires the respondents' awareness and vast knowledge and hence the choice of the experts with criteria mentioned above to be strictly followed.

#### 2.2.2 Respondents Selection

The sample of respondents who is able to provide the information needed for the purpose of the study would be selected depends on the experience of the employees of the Libyan ICT sector, particularly technicians, engineers, supervisors, managers involved in TT process in their respective Telecommunication and Information Technology companies.

#### 2.2.3 Sample Size Determination

To find the appropriate sample size for this research, the formula that followed is that formula, which published by the research division of the National Education Association (NEA Research) Bulletin, and accompanied with easy reference table (Krejcie & Morgan 1970).

s = X^2NP (1− P) ÷ d^2 (N −1) + X^2P (1− P)

s = required sample size.

X^2= the table value of chi-square for 1 degree of freedom at the desired confidence level

(3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum x^2sample size).

d = the degree of accuracy expressed as a proportion (.05).

## 3. Results

### *3.1 Data Screening*

The data screening process is conducted to ensure that the data available matches the sampling criteria, guarantee the accuracy of data entry, and specify and treat questionnaires with unanswered items. According to Schafer (1997), responses with more than 5% of missing data should be excluded from further analysis. Besides, responses are excluded based on the sampling criteria guidelines. The received questionnaires were checked against missing data. Few numbers of questionnaires had missing data. These missing data were not more than 5% and was replaced by the mean score (mean substitute method of missing data). As the purpose of this study is to solicit information from an expert who participated in previous TT process with an international partner, it was found that a number of respondents did not indicate any information about participation in TT process; those questionnaires were excluded from further analysis.

Among the 162 received answers, 11 responses were excluded due to that do not adhere with specified sampling criteria such as non-availability of valid experience in TT projects with foreign entities, outliers, missing information, and unengaged response.

### *3.2 Respondent Profile*

Gathering the personal characteristics of the respondents was essential to develop a good understanding of their perspective on the TT process and their field of specialization. The evaluation of the position held by respondents was necessary to confirm the validity and reliability of responses. Determining the experience of process participants was decisive for ensuring the validity of results. The greater the experience of the respondent in the ICT industry means a higher understanding of process performance and influences.

Respondents were requested to detail their qualifications to confirm they are qualified enough to develop an informed perspective on the ITT process. The aim was to develop a greater understanding of the respondent's exposure to ITT and their experience in the local ICT industry sector. Table 1 summarizes the respondent profile (position- experience -education), according to the position of the respondents results, the majority were engineers with a (41.1%); followed by the technician (17.9%); administrative officer (9.9%); and Project Supervisor (8.6%). The highest frequency of respondents had a bachelor degree (48.3%) while the Diploma holders come with (28.5%) and Master holders percentage (18.5%) followed by the doctorate (4%). Table 3 shows that the respondents have various working experience ranging from less than five years to more than 20 years. The respondents with experience of 6 to 10 years got the highest frequency (39.1%).

Table 3. Respondent Profile

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| **Position** | | | | |
| Manger | 8 | 5.3 | 5.3 | 5.3 |
| Project Supervisor | 13 | 8.6 | 8.6 | 13.9 |
| Consultant | 6 | 4.0 | 4.0 | 17.9 |
| Academic Staff | 10 | 6.6 | 6.6 | 24.5 |
| Engineer | 62 | 41.1 | 41.1 | 65.6 |
| Technician | 27 | 17.9 | 17.9 | 83.4 |
| Administrative Officer | 15 | 9.9 | 9.9 | 93.4 |
| Others | 10 | 6.6 | 6.6 | 100.0 |
| Total | 151 | 100.0 | 100.0 | |
| **Experience** | | | | |
| less than five years | 27 | 17.9 | 17.9 | 17.9 |
| 6-10 years | 59 | 39.1 | 39.1 | 57.0 |
| 11-15 years | 35 | 23.2 | 23.2 | 80.1 |
| 16-20 | 20 | 13.2 | 13.2 | 93.4 |
| more than 20 years | 10 | 6.6 | 6.6 | 100.0 |
| Total | 151 | 100.0 | 100.0 | |
| **Education** | | | | |
| Diploma | 43 | 28.5 | 28.5 | 28.5 |
| Bachelor | 73 | 48.3 | 48.3 | 76.8 |
| Master | 28 | 18.5 | 18.5 | 95.4 |
| Doctorate | 6 | 4.0 | 4.0 | 99.3 |
| Other | 1 | .7 | .7 | 100.0 |
| **Total** | 151 | 100.0 | 100.0 | |

*3.2 Exploratory Factor Analysis (EFA)*

The purpose of implementing exploratory factor analysis (EFA) is to reduce or trim the number of sub-factors, to establish reliable and validated measures for the factors under investigation of this study. Furthermore, the goal of using EFA is to combine the sub-factor according to a theoretical conceptual. However prior to implementation of exploratory factor analysis (EFA), several assumptions were checked. As suggested by Hair et al. (2006) several assumptions to be tested, before the implementation of EFA. Such assumptions are the univariate normality of all sub-factors, anti-image correlation matrix. The sub-factors should have factorability (adequacy of the sample size to perform EFA), which is measured by KMO (Kaiser – Mayer – Olkin) and Barlett test.

Table 4. Indices index

| Indices | Measured by | Recommended range | references |
|---|---|---|---|
| Sample size | | > 100 | Hair et al. (2010); and Mundfrom, (2005) |
| Univariate normality | Skewness and Kurtosis | absolute 2 | Hair et al. (1998) |
| Factorability. | anti-image correlation matrix | All the diagonal elements > 0.5 and the off- diagonal elements have low correlation. | Hair et al. (2006). Williams, Brown & Onsman (2012) |
| | KMO (Kaiser – Meyer Olkin) | ≥ 0.5 | Kaiser (1974) |
| Emerging factors | Eigenvalues | > 1 | Garson, 2010 |
| Factor loadings | | > 0.5 | Charles Zaiontz. (2013) |
| Reliability | Cronbach's Alpha | > 0.60 | Hair et al., 2010 |

3.2.1 TT Government Support Initiatives

Reflecting the assumptions mentioned above, it was found that all sub-factors related to the TT government support initiatives satisfy the condition of univariate normality, as all the sub-factors has skewness and kurtosis fall within the recommended range to indicate normality. As advised by Hair et al. (1998), the recommended value is absolute two for both skewness and kurtosis. Table 5 displays the corresponding skewness and kurtosis values.

Table 5. Descriptive Statistics

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| A2.1 | 151 | -1.158 | .197 | .857 | .392 |
| A2.2 | 151 | -1.004 | .197 | .643 | .392 |
| A2.3 | 151 | -.574 | .197 | -.359 | .392 |
| A2.4 | 151 | -.961 | .197 | .776 | .392 |
| A2.5 | 151 | -.653 | .197 | -.022 | .392 |

Furthermore, to ensure the adequacy of sample size, the associated KMO test was examined. Kaiser (1974) recommended the value of KMO to be above 0.5 and Bartlett's Test of Sphericity to be significant (P-value <0.05), to make the statistical inference that there is factorability. With inspection of Table 6, the KMO test reported a value of 0.767, which is above the recommended threshold of 0.5, additionally, the Bartlett's Test of Sphericity indicated a significant P value (Sig. = 0.000). Such statistical values satisfy the condition of EFA implementation, and the data, therefore, possess factorability.

Table 6. KMO and Bartlett's Test

| Kaiser-Meyer-Olkin | Measure of Sampling Adequacy. | .767 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 237.363 |
| | df | 10 |
| | Sig. | .000 |

Furthermore, the anti-image correlation table depicted in Table 7 showed the satisfaction of EFA implementation conditions; that is all the diagonal elements should exceed the value of 0.5, and the off- diagonal elements have a very low correlation, as recommended by Hair et al. (2006). Therefore, it could be said that implementing EFA on the items related to TT Government Support Initiatives is justified.

Table 7. Anti-image Matrix [a]

| | A2.1 | A2.2 | A2.3 | A2.4 | A2.5 |
|---|---|---|---|---|---|
| A2.1 | **.863**[a] | -.153 | -.216 | -.075 | -.084 |
| A2.2 | -.153 | **.818**[a] | -.036 | -.353 | -.024 |
| A2.3 | -.216 | -.036 | **.839**[a] | -.068 | -.270 |
| A2.4 | -.075 | -.353 | -.068 | **.709**[a] | -.569 |
| A2.5 | -.084 | -.024 | -.270 | -.569 | **.725**[a] |

a. Measures of Sampling Adequacy(MSA)

Since the assumptions of EFA were met, the implementing of exploratory factor analysis (EFA) with the use of varimax principal component method had resulted into a single factor solution, as it was theorized. Since this factor represents a single dimension, therefore, the theoretical expectation would suggest an emerging of single factor solution.

The inference of single factor solution was detected through inspecting the eigenvalues. The eigenvalues that are above 1 is an indication of emerging factors. Only one factor has emerged since the eigenvalues presented in Table 8 has only one eigenvalue above 1 that is equal to 2.764. The emerged single factor was able to explain 55.279 percent of the variance. This means that all the five sub-factors were able to explain 55.279 percent of the variation to the corresponding factor. Totally explained the variance of little as 50 percent is deemed acceptable, especially for a single factor solution (Garson, 2010).

Table 8. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.764 | 55.279 | 55.279 | 2.764 | 55.279 | 55.279 |
| 2 | .760 | 15.196 | 70.475 | | | |
| 3 | .690 | 13.808 | 84.283 | | | |
| 4 | .521 | 10.421 | 94.704 | | | |
| 5 | .265 | 5.296 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

On the other hand, all the sub-factors has adequate loading that fall within the recommended range of above 0.5, as suggested by Hair et al. (2006). Therefore, the analysis will further proceed with all sub-factors related to the TT government support initiatives, without any further exclusion. The factor loadings are reflected in Table 9 and they are ranging from 0.628 until 0.848, and the reliability test shows that the factor has a reliability of 0.794.

Table 9. Component Matrix [a]

| | Component |
|---|---|
| | 1 |
| A2.1 | .628 |
| A2.2 | .695 |
| A2.3 | .689 |
| A2.4 | .848 |
| A2.5 | .833 |
| Reliability Statistics | |
| Cronbach's Alpha | .794 |
| N of Items | 5 |

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

3.2.2 Learning Centers and ICT entrepreneurs Learning Capability

The same assumptions before the EFA implementation were checked against the sub-factors related to the learning ICT entrepreneurs Learning Capability. As previously mentioned, EFA assumptions were investigated in terms of univariate normality. As shown in Table 10, the skewness and kurtosis values for all sub-factors related the learning centers and ICT entrepreneurs learning capability fall within the recommended range to indicate normality; all the values did not exceed absolute 2 of skewness and kurtosis.

Table 10. Descriptive Statistics

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| B2.1 | 151 | -1.352 | .197 | 1.285 | .392 |
| B2.2 | 151 | -.906 | .197 | .597 | .392 |
| B2.3 | 151 | -.766 | .197 | .288 | .392 |
| B2.4 | 151 | -.985 | .197 | .281 | .392 |

Furthermore, KMO test was performed to judge on the sample adequacy of the learning centers and ICT entrepreneurs learning capability data. The results displayed in Table 11 indicate that the sample size of these data was adequate. . In addition, Bartlett's Test of Sphericity was significant, which indicates that the use of EFA is appropriate.

Table 11. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .775 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 318.837 |
| | df | 6 |
| | Sig. | .000 |

The last assumptions of the successful implementation of EFA were investigated through the anti-image correlation matrix. As displayed in Table 12, all the diagonal elements of the anti-image matrix have the value of above 0.5 and off-diagonal element with weak correlations.

Table 12. Anti-image Matrix [a]

| | B2.1 | B2.2 | B2.3 | B2.4 |
|---|---|---|---|---|
| B2.1 | .738[a] | -.500 | -.447 | .087 |
| B2.2 | -.500 | .797[a] | -.210 | -.182 |
| B2.3 | -.447 | -.210 | .774[a] | -.392 |
| B2.4 | .087 | -.182 | -.392 | .804[a] |

a. Measures of Sampling Adequacy(MSA).

By using the principle component analysis (CPA) with a use of the varimax rotational method, a single factor solution was extracted, as indicated by the eigenvalue score shown in Table 13. Such a single factor solution matches the theoretical conceptual that the sub-factors represent one dimension. Moreover, the four sub-factors used to represent the learning centers and ICT entrepreneurs learning capability was explaining 71.655 per cent of variation, which deemed to be excellent and exceeds the minimum cut-off 50 percent. The use of single factor solution is justified, since the learning centers and ICT entrepreneurs learning capability theoretically a distinctive dimension that has no theoretical relationship with other factors in this study, hence, the use of the single-factor solution is deemed an appropriate choice.

Table 13. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.866 | 71.655 | 71.655 | 2.866 | 71.655 | 71.655 |
| 2 | .615 | 15.378 | 87.033 | | | |
| 3 | .300 | 7.493 | 94.526 | | | |
| 4 | .219 | 5.474 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

In addition, with reference Table14, all the sub-factors have adequate factor loadings that exceed the threshold of 0.5, and the reliability test shows that the factor has a reliability of 0.862. Accordingly, the analysis will proceed with all sub-factors as they do not pose any threat to the validity at the later stage of analysis.

Table 14. Component Matrix [a]

| | Component |
|---|---|
| | 1 |
| B2.1 | .874 |
| B2.2 | .877 |
| B2.3 | .897 |
| B2.4 | .727 |
| Reliability Statistics | |
| Cronbach's Alpha | .862 |
| N of Items | 4 |

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

3.2.3 Transferor's Characteristics

The same assumptions were investigated. Table 15 reflects that the sub-factors of Transferor's characteristics have skewness and kurtosis within the recommended range, which further indicate that all sub-factors belong to this factor possess univariate normality.

Table 15. Descriptive Statistics

| | N | **Skewness** | | **Kurtosis** | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| C2.1 | 151 | -.714 | .197 | .289 | .392 |
| C2.2 | 151 | -.452 | .197 | -.898 | .392 |
| C2.3 | 151 | -.758 | .197 | .383 | .392 |
| C2.4 | 151 | -.816 | .197 | .582 | .392 |

Both conditions of sample adequacy and anti-image correlation were satisfied and, therefore, the implementation of a single factor solution is permissible. Such results are displayed respectively in Table 16 and 17.

Table 16. KMO and Bartlett's Test

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .731 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 91.656 |
| | df | 6 |
| | Sig. | .000 |

Table 17. Anti-image Matrix [a]

| | C2.1 | C2.2 | C2.3 | C2.4 |
|---|---|---|---|---|
| C2.1 | .749[a] | -.234 | -.217 | -.136 |
| C2.2 | -.234 | .735[a] | -.121 | -.262 |
| C2.3 | -.217 | -.121 | .729[a] | -.289 |
| C2.4 | -.136 | -.262 | -.289 | .715[a] |

a. Measures of Sampling Adequacy(MSA).

Additionally, as the theory was stated, a single factor emerged from the EFA implementation. The sub-factors related to Transferor's characteristics were able to explain 51.950 percent of the factor, as shown in Table 18. Such total variance is sufficient and meets the minimum threshold of acceptable total variance explained.

Table 18. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.078 | 51.950 | 51.950 | 2.078 | 51.950 | 51.950 |
| 2 | .697 | 17.436 | 69.386 | | | |
| 3 | .673 | 16.828 | 86.215 | | | |
| 4 | .551 | 13.785 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

All the corresponding sub-factors of organizational performance showed an appropriate loading that fall within the range of recommended (above 0.5). Hence, no sub-factors were deleted for subsequent analysis. Such factor loadings are reflected in Table 19 and ranging from .700 until .746, and the reliability test shows that the factor has a reliability of 0.691.

Table 19. Component Matrix [a]

| | Component |
|---|---|
| | 1 |
| C2.1 | .700 |
| C2.2 | .716 |
| C2.3 | .721 |
| C2.4 | .746 |
| Reliability Statistics | |
| Cronbach's Alpha | .691 |
| No of Items | 4 |

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

3.2.4 Transferee's Characteristic

As indicated in Table 20, all the sub-factors has skewness and kurtosis within the recommended range of not more than absolute 2.

Table 20. Descriptive Statistics

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| D2.1 | 151 | -.775 | .197 | .330 | .392 |
| D2.2 | 151 | -.224 | .197 | -.878 | .392 |
| D2.3 | 151 | -.505 | .197 | -.217 | .392 |
| D2.4 | 151 | -.757 | .197 | .019 | .392 |

The initial inspection of the EFA assumptions related to the sub-factors of Transferee's characteristic impact yielded undesirable statistical inference. As KMO test was on the borderline, as well as the total variance explained was below the minimum acceptable value of 50 per cent. Accordingly, the sub-factors with lowest factor loading (D2.3) were removed from the analysis, in the attempt to improve the overall result and satisfy the EFA conditions. Subsequent to the removal of the D2.3, the results show improvement. This demonstrated by the KMO test that had improved to 0.597, with significant Test of Sphericity. Furthermore, the diagonal element of anti-image correlation has the value of above 0.5, as shown in Table 21 & 22, respectively.

Table 21. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .597 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 55.527 |
| | df | 3 |
| | Sig. | .000 |

Table 22. Anti-image Matrix [a]

| | D2.1 | D2.2 | D2.4 |
|---|---|---|---|
| D2.1 | .597[a] | -.076 | -.409 |
| D2.2 | -.076 | .658[a] | -.297 |
| D2.4 | -.409 | -.297 | .568[a] |

a. Measures of Sampling Adequacy(MSA).

The total variance explained, which was the main cause of the problem has improved after removing D2.3. Initially, the total explained variance was 43.42 percent; however, it was improved to 56.711 percent, which exceeds the threshold. This statistical figure is present in Table 23. Even with removing D2.3, a single factor emerged, whereby the retained sub-factors were able to explain 56.711 percent. The eigenvalues score indicate the single factor solution, which there was only one value that exceeds 1 and it was equal to 1.701.

Table 23. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 1.701 | 56.711 | 56.711 | 1.701 | 56.711 | 56.711 |
| 2 | .782 | 26.063 | 82.773 | | | |
| 3 | .517 | 17.227 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

The three retained sub-factors have factor loadings that exceed the threshold of 0.5. As shown in Table 23, the factor loadings are ranging from 0.752 until 0.830, and the reliability test shows that the factor has a reliability of 0.611.

Table 23. Component Matrix [a]

| | Component |
|---|---|
| | 1 |
| D2.1 | .752 |
| D2.2 | .669 |
| D2.4 | .830 |
| Reliability Statistics | |
| Cronbach's Alpha | .611 |
| N of Items | 3 |

3.2.5 TT process. (TT environment)

Table 25 reflects the skewness and kurtosis for the sub-factors related to TT process factor. The condition of univariate normality is satisfied through the inspection of skewness and kurtosis values, which fall within the recommended range.

Table 25. Descriptive Statistics

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| E2.1 | 151 | -.536 | .197 | -.184 | .392 |
| E2.2 | 151 | -.310 | .197 | -.534 | .392 |
| E2.3 | 151 | -.371 | .197 | -.294 | .392 |
| E2.4 | 151 | -.869 | .197 | .433 | .392 |
| E2.5 | 151 | -.554 | .197 | -.007 | .392 |
| E2.6 | 151 | -.415 | .197 | -.445 | .392 |

The initial inspection of the single factor solution has resulted in poor total variance explained. Therefore, there was a need to improve the statistical figures. Such improvement is achieved by removing sub-factors with low loading. The inspection of factor loadings, suggested the removal of E2.4 & E2.6, as they had the lowest factor loadings.

With such removal, the assumption of EFA was revisited. The KMO and Bartlett's Tests in Table 26 shows that the condition of factorability is attained, as KMO test has the value of 0.737 that is above the threshold of 0.5 and the Bartlett's Test is significant.

Table 26. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .737 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 103.208 |
| | df | 6 |
| | Sig. | .000 |

In addition, the anti-image matrix has diagonal elements of the values of more than 0.5, as seen in Table 27.

Table 27. Anti-image Matrix [a]

| | E2.1 | E2.2 | E2.3 | E2.5 |
|---|---|---|---|---|
| E2.1 | .725[a] | -.337 | -.146 | -.224 |
| E2.2 | -.337 | .703[a] | -.261 | -.219 |
| E2.3 | -.146 | -.261 | .775[a] | -.090 |
| E2.5 | -.224 | -.219 | -.090 | .775[a] |

a. Measures of Sampling Adequacy(MSA).

With the deletion of E2.4 and E2.6, the total variance explained has been further improved. It was improved to 52.238 per cent, before the improvement made, the total explained variance was merely 40 percent. Yet, the retained four sub-factors were able to extract a single factor solution with total variance explanation of 52.238 per cent. Such statistical figures are presented in Table 28.

Table 28. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.130 | 53.238 | 53.238 | 2.130 | 53.238 | 53.238 |
| 2 | .744 | 18.608 | 71.846 | | | |
| 3 | .619 | 15.487 | 87.333 | | | |
| 4 | .507 | 12.667 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

The retained four factors were further checked in terms of their factor loadings. As shown in Table 29, all the retained sub-factors have the recommended value of factor loadings that exceeds the cutoff 0.5, and the reliability test shows that the factor has a reliability of 0.698.

Table 29. Component Matrix [a]

| | Component 1 |
|---|---|
| E2.1 | .765 |
| E2.2 | .796 |
| E2.3 | .663 |
| E2.5 | .686 |
| Reliability Statistics | |
| Cronbach's Alpha | .698 |
| No of Items | 4 |

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

### 3.2.6 Achievements

First, the sub-factors from A4.1 until D4.6 showed adequate univariate normality. The univariate normality was judged based on the corresponding values of skewness and kurtosis. As Table 30 indicated that all the skewness and kurtosis fall within the recommended range advised by Hair et al. (1998) to indicate that the items have univariate normality, the recommended value is absolute 2 for both skewness and kurtosis.

Table 30. Descriptive Statistics

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| A4.1 | 151 | -.368 | .197 | -.938 | .392 |
| A4.2 | 151 | -.455 | .197 | -.541 | .392 |
| A4.3 | 151 | -.316 | .197 | -.503 | .392 |
| A4.4 | 151 | -.568 | .197 | -.171 | .392 |
| A4.5 | 151 | -.839 | .197 | .589 | .392 |
| B4.1 | 151 | -.376 | .197 | -.791 | .392 |
| B4.2 | 151 | -.310 | .197 | -.707 | .392 |
| B4.3 | 151 | -.586 | .197 | -.438 | .392 |
| B4.4 | 151 | -.761 | .197 | .124 | .392 |
| B4.5 | 151 | -.628 | .197 | -.286 | .392 |
| C4.1 | 151 | -.461 | .197 | -.746 | .392 |
| C4.2 | 151 | -.363 | .197 | -.800 | .392 |
| C4.3 | 151 | -.504 | .197 | -.343 | .392 |
| C4.4 | 151 | -.519 | .197 | -.672 | .392 |
| D4.1 | 151 | -.554 | .197 | -.288 | .392 |
| D4.2 | 151 | -.523 | .197 | -.404 | .392 |
| D4.3 | 151 | -.723 | .197 | .495 | .392 |
| D4.4 | 151 | -.728 | .197 | .248 | .392 |
| D4.5 | 151 | -.841 | .197 | .835 | .392 |
| D4.6 | 151 | -.568 | .197 | .143 | .392 |

Secondly, as per requirement of the performing EFA, Hair et al. (1998) suggested that KMO test should have the value of above 0.5, which then indicate that the sample is adequate to perform EFA. As shown in Table 31, the KMO test has the value of 0.931, which indicates that the sample size is adequate to perform EFA.

Table 31. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .931 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1473.963 |
| | df | 120 |
| | Sig. | .000 |

Furthermore, the anti-image correlation table depicted in Table 32 showed the satisfaction of EFA implementation conditions; that is all the diagonal elements should exceed the value of 0.5, and the off-diagonal elements have a very low correlation, as recommended by Hair et al. (2006). Therefore, it could be said that implementing EFA on the sub-factors related to achievements is justified. On the hand, the total variance explained was again lower than the minimum acceptable percent; this necessitates removing some sub-factors to improve the total variance explained. Several sub-factors with lowest factor loadings were detected, and they were removed, such sub-factors are B4.2, C4.4, D4.1, and D4.2. This left the achievement to present with 16 sub-factors, instead of 20 sub-factors.

The retained 16 sub-factors were used for further analysis. As shown in Table 33, the 16 retained sub-factors were able to generate a single factor solution for the achievement with an appropriate total explained variance of 53.195 per cent. The single factor solution was indicated by the eigenvalue score of above 1. Moreover, all the retained 16 sub-factors have factor loadings that exceed the recommended value of 0.5, and the reliability test shows that the factor has a reliability of 0.698 as shown in Table 34.

Table 32. Anti-image Correlation Matrices

| | A4.1 | A4.2 | A4.3 | A4.4 | A4.5 | B4.1 | B4.3 | B4.4 | B4.5 | C4.1 | C4.2 | C4.3 | D4.3 | D4.4 | D4.5 | D4.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A4.1 | .944[a] | -.239 | -.130 | -.055 | -.082 | -.259 | .154 | -.089 | -.087 | .041 | -.055 | .032 | .054 | -.066 | .005 | -.067 |
| A4.2 | -.239 | .951[a] | -.158 | -.054 | -.137 | -.037 | -.082 | -.032 | .074 | -.261 | -.013 | -.021 | -.154 | .106 | -.041 | -.106 |
| A4.3 | -.130 | -.158 | .909[a] | -.212 | -.013 | .036 | -.068 | .134 | -.148 | .056 | -.035 | -.100 | -.010 | .073 | .133 | -.171 |
| A4.4 | -.055 | -.054 | -.212 | .912[a] | -.333 | .001 | .015 | .011 | .025 | .024 | -.110 | -.078 | -.200 | .037 | -.189 | .198 |
| A4.5 | -.082 | -.137 | -.013 | -.333 | .931[a] | .021 | -.045 | -.252 | -.005 | .020 | .080 | -.034 | .200 | -.117 | .000 | -.199 |
| B4.1 | -.259 | -.037 | .036 | .001 | .021 | .935[a] | -.371 | .002 | -.009 | -.199 | .045 | .037 | .026 | .039 | -.092 | -.040 |
| B4.3 | .154 | -.082 | -.068 | .015 | -.045 | -.371 | .926[a] | -.170 | -.280 | -.056 | -.222 | .081 | -.102 | .077 | .004 | -.055 |
| B4.4 | -.089 | -.032 | .134 | .011 | -.252 | .002 | -.170 | .932[a] | -.321 | -.089 | .055 | -.305 | -.018 | .036 | -.178 | .008 |
| B4.5 | -.087 | .074 | -.148 | .025 | -.005 | -.009 | -.280 | -.321 | .937[a] | -.103 | -.055 | .077 | .118 | -.120 | -.091 | .050 |
| C4.1 | .041 | -.261 | .056 | .024 | .020 | -.199 | -.056 | -.089 | -.103 | .937[a] | -.137 | -.225 | -.007 | -.231 | .189 | -.060 |
| C4.2 | -.055 | -.013 | -.035 | -.110 | .080 | .045 | -.222 | .055 | -.055 | -.137 | .950[a] | -.207 | .068 | -.166 | -.122 | .041 |
| C4.3 | .032 | -.021 | -.100 | -.078 | -.034 | .037 | .081 | -.305 | .077 | -.225 | -.207 | .931[a] | -.102 | -.032 | .010 | .096 |
| D4.3 | .054 | -.154 | -.010 | -.200 | .200 | .026 | -.102 | -.018 | .118 | -.007 | .068 | -.102 | .909[a] | -.346 | -.145 | -.119 |
| D4.4 | -.066 | .106 | .073 | .037 | -.117 | .039 | .077 | .036 | -.120 | -.231 | -.166 | -.032 | -.346 | .925[a] | -.088 | -.239 |
| D4.5 | .005 | -.041 | .133 | -.189 | .000 | -.092 | .004 | -.178 | -.091 | .189 | -.122 | .010 | -.145 | -.088 | .931[a] | -.351 |
| D4.6 | -.067 | -.106 | -.171 | .198 | -.199 | -.040 | -.055 | .008 | .050 | -.060 | .041 | .096 | -.119 | -.239 | -.351 | .924[a] |

a. Measures of Sampling Adequacy(MSA)

Table 33. Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 8.511 | 53.195 | 53.195 | 8.511 | 53.195 | 53.195 |
| 2 | .972 | 6.073 | 59.268 | | | |
| 3 | .935 | 5.842 | 65.110 | | | |
| 4 | .825 | 5.154 | 70.264 | | | |
| 5 | .696 | 4.350 | 74.615 | | | |
| 6 | .602 | 3.761 | 78.376 | | | |
| 7 | .544 | 3.401 | 81.776 | | | |
| 8 | .501 | 3.130 | 84.906 | | | |
| 9 | .434 | 2.712 | 87.618 | | | |
| 10 | .423 | 2.643 | 90.261 | | | |
| 11 | .367 | 2.294 | 92.555 | | | |
| 12 | .309 | 1.929 | 94.484 | | | |
| 13 | .243 | 1.522 | 96.005 | | | |
| 14 | .227 | 1.419 | 97.424 | | | |
| 15 | .214 | 1.338 | 98.762 | | | |
| 16 | .198 | 1.238 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

Table 34. Component Matrixa

| | **Component**<br>**1** |
|---|---|
| A4.1 | .701 |
| A4.2 | .795 |
| A4.3 | .532 |
| A4.4 | .658 |
| A4.5 | .753 |
| B4.1 | .726 |
| B4.3 | .791 |
| B4.4 | .826 |
| B4.5 | .755 |
| C4.1 | .785 |
| C4.2 | .711 |
| C4.3 | .674 |
| D4.3 | .650 |
| D4.4 | .749 |
| D4.5 | .755 |
| D4.6 | .756 |
| **Reliability Statistics** | |
| Cronbach's Alpha | .941 |
| No of Items | 16 |

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

## 4. Discussion

The ICT international technology transfer model was developed, and the affecting factors and sub factors were explored and defined. The developed model was empirically tested in Libyan ICT industry; a questionnaire survey was carried out on the sample targeting ICT companies' employees who have involved in TT processes. Respondents were requested to provide a rating for their opinion to the factors and their perceived impact on a TT process. The Statistical Package for the Social Sciences (SPSS 21) software was implemented to analyze the receiving data. The analysis included descriptive statistic to create a respondent profile. To minimize and establish reliable and validated measures for the factors under investigation of this study Exploratory Factor

Analysis (EFA) was implemented. Furthermore, the goal behind using (EFA) is to combine these sub-factors according to a theoretical conceptual. Several assumptions were tested prior to implementing the exploratory factor analysis (EFA): the univariate normality of all factors, anti-image correlation matrix, the factorability, and factors reliability. All the independent variables in this study emerged from a different theoretical background. Therefore, a single factor solution deemed to be appropriate, rather than implementing EFA on all the independent variables simultaneously.

The outcome of this analysis is the confirmed model for international TT in ICT projects, which includes a number of refined enabling and achievements variables. Among five enablers (factors) and their 23 sub-factors, the analysis retains only 20 and ignores 3 sub factors. The (EFA) grouped the following factors (enablers) in the developed model: TT government support initiatives, transferor characteristics, transferee characteristics, TT environment, learning centers, and their respective sub-factors (variables). On the hand, the outcome (achievements) construct has resulted with only 16 sub factors and 4 sub factors were ignored. This paper is a part of an ongoing study to develop a confirmed technology transfer model for the Libyan ICT industry. Utilizing the confirmatory factor analysis (CFA), and structural equation modeling (SEM) techniques will be the next phase to achieve more confirmation and validation of the model's remained factors and sub factors and to confirm the model structure and causal paths between factors.

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