

Academic Journal of Research and Scientific Publishing

International peer-reviewed scientific journal

The Thirty-Third Issue

Publication date: 05-01-2022

ISSN: 2706-6495

doi.org/10.52132/Ajrsp.e.2022.33

Email: editor@ajrsp.com



Dedication

It is our pleasure and great privilege to present the thirty-third issue of the Academic Journal of Research and Scientific Publishing to all researchers and doctors who published their research in the issue, and we thanks and appreciate to all contributors and supporters of the academic journal and those involved in the production of this scientific knowledge edifice.

Academic Journal of Research and Scientific Publishing



Editorial Board

Chief Editor:

Prof. Dr. Khetam Ahmed Al-Najdi

Advisory Members:

Dr. Aicha abdelhamid eltteli abdelhamid

Prof. Dr. Riad Said Ali Al-Mutairi

Editorial Members:

Dr. Azab Alaziz Alhashemi

- Prof. Dr. Saleh Bashir Bin Sulaiman Bouchelaghem
- Prof. Dr. Khaled Ibrahem Khalil Hijazi Abu Alqumsan
- Dr. Abu Obida Taha Gebreel Ali
- Dr. Badreddine Berahlia,
- Dr. Zainab Ridha Hammoodi Aljwaid,
- Dr. Basma Mortada Mohamed Foda
- Dr. Wisal Ali Al-hommada
- Dr. Bilal Khalaf Ali Alzboun
- Dr. Tameem Mosa Alkrad,
- Dr. Walaa Al-Kurdi
- Prof. Dr. Khaled Mohamed Abdel-Fattah Abu Shaira
- Dr. Badir Mohamed
- Dr. Abdulameer Abbas Al-khamees Ali
- Dr. Nawal Hussein Siddig



Table of Content:

| No | Paper title | Author Name | Country | Field | Page No |
|----|--|---|-----------------|----------------------------|---------|
| 1 | Mechanism of Silver Nanoparticles Deposition by Electrolysis and Electroless Methods on a Graphite Substrate | Prof. Dr. Mahmoud A. Rabah, Prof. Dr. Nabil Nassif Girgis | Egypt | Chemistry | 5-20 |
| 2 | The Impact of Resistance to Change on the Implementation of Quality Management System in the Ministry of Education (General Directorate of Education in South Batinah Governorate as a Model) | Mr. Hamed Salim Said AL Basami | Oman | Business Administration | 21-58 |
| 3 | Cyber Attacks Visualization and Prediction in Complex Multi-Stage Network | Mr. Jassir Adel Altheyabi | Saudi Arabia | Cyber Security | 59-85 |
| 4 | Cognitive Stylistic Conceptualization of Legal Translation | Dr. Hasan Said Ghazala | Saudi Arabia | Social Sciences | 86-102 |
| 5 | Construction Solutions of Ordinary and Partial Differential Equations using the Analytical and Numerical Methods | Turkia Dhawi Alqurashi | Saudi Arabia | Mathematics | 103-120 |
| 6 | Expression of Heat Shock Protein HSP90 in Genomic- DNA of Chickpea (Cicer arietinum L.) Callus by Heat Shock Treatment | Anwaar F AL- Taee, Dr. Jamella H Rasheed | Iraq | Biology | 121-139 |



Mechanism of Silver Nanoparticles Deposition by Electrolysis and Electroless Methods on a Graphite Substrate

Prof. Dr. Mahmoud A. Rabah*

Chemical and electrochemical treatment Lab. Mineral Processing Dept., Central metallurgical Research and Development Institute (CMRDI), El-Flezzat Str. El-Tebbin, Cairo, Egypt. <u>0000-0002-1609-4203</u>

Email: mrabah010@gmail.com

Prof. Dr. Nabil Nassif Girgis

Control and Surface Protection Lab, Central metallurgical Research and Development Institute (CMRDI), El-Flezzat Str. El-Tebbin, Cairo, Egypt Email: <u>nabilnassif01@hotmail.com</u>

Abstract

This study shows a *silver* electrodeposition model (EDM) on a graphite substrate. The electrolyte was a 0.01 M solution of pure silver and chromium nitrate using an electrolyzing cell. EDC with current density up to 20 mA/cm^2 and 15 mV and pulse current were studied. Results revealed that silver deposited at a rate of 0.515 mg/cm²/min with 12 mA /cm² that decreases to 0.21 and 0.16 mg/cm².min with the decrease of current density to 6 and 5 mA/cm² respectively. The model postulates that silver ions (a) were first hydrated before diffusing (b) from the solution bulk to the cathode vicinity, the next step (c) involved the chemical adsorption of these ions on certain accessible sites of the graphite substrate (anode), the discharged entities (d) adhere to the graphite surface by *Van der Vales* force. Silver ions are deposited because the discharge potential of silver is low (0.38 mV) as compared to other metal ions like chromium (0.82 mV). Pulse current controls silver deposition due to flexibility in controlling steps (a) - (c) of the deposition mechanisms.



Parameters like current density, current on-time, current-off time, duty cycle (ratio of current on time and total pulse time) and pulse frequency influenced the shape and size of the deposits. Step (b) suggested that silver particles were deposited in a monolayer thickness. The silver layer turned multiple after fully satisfying the accessible sites with the monolayer. The activation energy ΔE value amounts to 86.32 kJ/mol/K. At high temperature and current density, homogeneous diffusion occurs.

Keywords: Silver and chromium nanoparticles, Electrolysis, Electroless deposition, Chemical deposition, Pulse current, Graphite substrate.

1- Introduction

The process of electroless deposition of silver as affected by galvanic displacement on the semiconducting substrates is a well-known process. This deposition process proceeds via two concurrent electrochemical reactions involving the reduction of metal ions and simultaneous oxidation of the substrate surface. It was reported that a uniform silver film about 50 nm thick was obtained on a graphite thin sheet (GN) surface via an improved electroless plating method (sun et. al 2008). The authors used 3-aminepropyltrimethoxysilane (APTMS) as an encapsulate to help to limit growth and aggregate formation. Other methods such as electrodeposition (Riccardis 2005), chemical vapour deposition (Yoshinaga et. al 2007) and electrophoretic deposition (Luo et. al 2006) have been claimed for surface metallization of materials. Srikanth et/ al (2009) showed metallic silver was deposited on the surface of synthesized calcite via a simple that electroless deposition method. Calcite with cubic morphology was prepared first by homogeneous precipitation and with subsequent surface modification using ammonium oxalate. Tang et. al (2007). reported ultrasonic electro-deposition of silver nanoparticles on dielectric silica spheres [6]. The authors showed that silver nanoparticles with sizes of 8-10 nm in diameter could be homogeneously deposited onto the surface of preformed colloidal silica spheres. Silver particles with different sizes and dispersive uniformity on silica sphere surfaces were obtained by adjusting the current density, the concentration of electrolyte and the electrolysis time. The possible ultrasonic electrodeposition mechanism was also suggested. An electrochemical multiple scan cyclic voltammetry (CV) method (Sondi and Goia 2003) was executed to prepare surface-enhanced Raman scattering (SERS) active silver films, to investigate the effect of potential scan rate and the number of CV scans on the SERS performance.

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



Silver nanoparticles was synthesized by the reduction of silver nitrate using a reducing agent of ethylene glycol with polyvinylpyrrolidone. Ethylene glycol containing hydroxyl groups have a functional structure as both solvent and reducing agents. The SERS enhancement capability is particle size and distribution as well surface profile amplitude-dependent with an optimal potential scan rate of 100 mV/s and 30 CV scans at the experimental conditions used. The highest SERS effect associated with the homogeneously distributed uniform size aggregates merged to interconnecting network as confirmed by scanning electron microscopy and optical profilometry investigation. Rabah (2013) prepared preparation of size-controlled silver nanoparticles on graphite substrate from e-waste. The route involved the extraction of the metals available in nitric acid followed by treatment with hydrofluoric acid. Silver metal particles deposited with an average size of 4-10nm. A stabilizer concentration of 10-40g/l was used. N.V. Mandich (2021) showed that Cr^{3+} is reduced to chromium metal at 0.74 V. A pulsed electrochemical system was constructed to synthesize size-controllable spherical silver nanoparticles (AgNPs) in the aqueous phase (Wang et. al. 2005, Cuenya, 2010 and Orináková et. al 2013) The circulation system greatly reduces silver deposition rate, thereby making well-dispersed silver nanoparticles colloids to synthesize very conveniently without ultrasonication and string system. Moreover, the particle size of AgNPs was controlled by the experimental parameters (on-time, off-time, and peak current) to improve the homogeneity of the prepared AgNPs. The smallest sized AgNPs with a size of 14.9±4 nm were obtained with an on-time, off-time, and peak current of 0.8 ms, 0.3 ms, and 0.2 A, respectively. In addition, a clear correlation between the size of silver particles and the peak current was found in that system. Samanta et. al. (2019) studied the deposition mechanism of silver and gold nanoparticles. The authors showed that biomolecular mechanisms deposition of Au and Ag NPs will be helpful for the fabrication of desired shape, size, surface charges and stability. The mechanism of deposition of monolayer nano-silver particles from silver nitrate solution by electroless deposition has also been reported.. The model involves hydration of the metal atoms and diffusion of the hydrated ions from the solution bulk to the cathode vicinity (Cao et. al 2014) in preference to ion discharge (Pilone and Kelsall 2006). The characteristic quality of the product was determined with the XRD, FTIR and SEM measurements Silver first diffuse and deposit in preference to chromium because its ionic size and discharge potential is lower than with chromium (Song et. al 2011, Sun and Xia 2002) Chromium ions then diffuse and deposit on the silver particles, the metal silver is catalytically reactive (Zhu et. al 2000).



Moreover, it has been shown that the degree of polymerization and concentration of the stabilizing polymer substrate have a marked influence on the size and properties of the deposit the controlling the deposition parameters such as the current density, current-on time, current-off time, duty cycle (ratio of current on time and total pulse time) and pulse frequency.

This study predicts a mechanism model for silver and chromium nanoparticles deposition by electrolysis and electroless methods on a graphite substrate. Influential parameters affect the deposition such as electrolyte concentration, current density, temperature, current on-time, current-off time, duty cycle (ratio of current on time and total pulse time) and pulse frequency have been studied. The model suggests that silver nanoparticles deposited in preference to chromium on accessible sites of the substrate. Only multiple-layer would take place after satisfying these accessible sites with a silver mono layer

2- Experimental

2.1 Materials and Methods

Pure grade chemicals of Aldrich of silver nitrate, potassium nitrate and potassium hydroxide were used in this work Glassy graphite thin plates having the dimensions 2x10x30 mm and graphite-doped polypropylene sheet 0.3 mm in thickness were the substrate for silver and chromium deposition. Doubly distilled water was used to prepare the electrolyte.

2.2 Description of the method for silver and chromium nanoparticles deposition

Alkaline 0.1N silver electrolyte having a pH value of 8.1 - 10.2 by addition of potassium hydroxide is used. Potassium nitrate solution of 0.05 N was added as a stabilizing agent. Table 1 shows the conditions of electrodeposition of silver on graphite substrate.

| Parameter | Concentration of materials, g/l | | | |
|--|---------------------------------|--------------|------------------|--|
| | Ag/ Cr | KCN | KNO ₃ | |
| concentration | 0.78/ 0.5 | 3.02 | 0.1M | |
| рН | 8.1 - 10.2 | 1 | | |
| Time, t, s | 2, 4, 6, 12, 30 | , 60 and 120 | | |
| pulsed current, t_{on} and t_{off} | 1 (s) | | | |
| Peak current density, mA/cm ² | 0.33, 0.45, 0.67, 1, 1.5 | | | |
| Temperature, $^{\circ}C$ | 25, 50, 75 | | | |



| Nr. | <i>c. d.</i> | t | pH | ton | toff | A (Area of |
|-----|--------------|----|------|-----|------|----------------------------|
| | | | | | | cathode, cm ²) |
| 1 | 12 | 2 | 9.1 | 1 | 1 | 1.7-2.7 |
| 2 | 6 | 2 | 9.1 | 1 | 1 | 1.7-2.7 |
| 3 | 5 | 2 | 9.1 | 1 | 1 | 1.7-2.7 |
| 4 | 4 | 2 | 9.1 | 1 | 1 | 1.7-2.7 |
| 5 | 3 | 2 | 9.1 | 1 | 1 | 1.7-2.7 |
| 6 | 6 | 4 | 9.1 | 1 | 1 | 1.7-2.7 |
| 7 | 6 | 8 | 9.1 | 1 | 1 | 1.7-2.7 |
| 8 | 6 | 12 | 9.1 | 1 | 1 | 1.7-2.7 |
| 9 | 6 | 16 | 9.1 | 1 | 1 | 1.7-2.7 |
| 10 | 6 | 20 | 8.3 | 1 | 1 | 1.7-2.7 |
| 11 | 8 | 2 | 8.3 | 1 | 1 | 1.7-2.7 |
| 12 | 6 | 2 | 10.3 | 1 | 1 | 1.7-2.7 |

Table (2) shows the experimental conditions of the work done

2.4. Deposition of silver with the chemical reduction method

An impregnating device has been developed. It is composed of a dissector containing a dish filled with silver solution. The dissector led is connected to a vacuum pump fitted with a valve. Graphite cathode were heated at 100-120°C outside the dissector and then carefully supported while hot on the edges of silver pot in the dissector. The dissector lid is placed and the vacuum valve is switched on to attain 5 mm Hg. The graphite sample was kept under vacuum for 30 minutes after which the vacuum valve is closed. The dissector was gently shacked to allow the graphite to fall in the silver pot. The vacuum tap is disconnected to maintain atmospheric pressure. After 1 h, the graphite samples were taken out and dried in a drier. The loaded graphite was immersed in hydrazine hydrate to reduce silver nitrate to yield silver metal. The chemical process of silver deposition can be repeated several times to control the layer thickness of the deposit.

2.5 Deposition of silver/ chromium with the electrolysis and electroless methods

An electrolyzing cell was developed to carry out the deposition of silver/ chromium from nitrate electrolyte. The cell is a one compartment box made of Perspex 6 mm thick. The cell is fitted with cover supporting the anode, the cathode, a separating funnel and a glass stirrer,



The electrodes were made of graphite-doped polymer sheet 0.3 mm un thickness connected to the *DC* main with precise regulator. Fig. 1 shows a schematic diagram of the electrolysis assembly.

2.6 Measurements of the physicochemical properties

Identification and thickness of the deposited silver on the substrate was determined with weight, X RF and SEM. Phase identification of the ppt metal is performed at room temperature using X-ray diffraction (X RD, Bruker axes D8, Germany) with Cu-K α ($\lambda = 1.5406$ Å) radiation and secondary mono-chromate in the range 2 θ -scale from 20 to 70 degree. The morphology information of the samples such as particle size and particle shape was investigated using transmission electron microscopy TEM with an acceleration voltage up to 120 kV, a magnification power up to 600 k, and a resolving power down to 0.2 nm (TEM, JEOL-JEM-1230, Tokyo, Japan). Scanning electron microscope (SEM) JEOL instrument model JSM-5410 was used to determine the microstructure of the deposited silver. The Fourier transform infrared (FT-IR) spectra were recorded on a Jasco FT-IR-3600 pulse



Fig. 1 A schematic diagram of the electrolysis assembly

2- Results

Table 3 shows the specific rate of silver deposition on graphite substrate

| Sample | | Time, <i>t</i> , | Rate of deposition, | |
|--------|------|------------------|-----------------------------|--|
| Nr. | C.d. | min | (Ag)mg/cm ² /min | |
| 2 | 6 | 2 | 0.217 | |
| 3 | 5 | 2 | 0.169 | |

Table (3) the specific deposition rate of silver and chromium on graphite substrate

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495

| 6 | 6 | 4 | 0.152 | |
|---|---|----|-------|--|
| 8 | 6 | 12 | 0.097 | |
| 9 | 6 | 16 | 0.056 | |

Fig 3 shows the deposited weight of silver as a function of electrolyte concentration. It is seen that the rate of deposition amounts to 0.515 mg/cm²/min with 12 mA/cm² and decreases to 0.21 and 0.16 mg/ cm² with a current density of 6 and 5 mA/cm² respectively



Fig 2 the deposited weight of silver as a function of electrolyte concentration, pH = 9.1

Fig. 2 shows the specific rate of deposition of silver metal (d) on graphite. It is seen that d value decreases linearly with time. Figure 4 shows the rate of silver deposition on graphite as a function of time. It is seen that the rate passes through plateau for the first 6 minutes after which it drastically increases to a maximum value at 8 minutes. After which the rate value decreases with further increase in time. It is seen that the rate of weight deposition of the metal (Ag or Cr) is kept nearly at the same magnitude within the first 5 minutes after which it increases sharply to attain its optimum value with 8 minutes. The extent of the rate of deposition decreases with increasing the time. Fig. 4 shows the effect of temperature on the deposition rate.



Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495





Fig. 3 Effect of temperature on the deposition rate, pH = 9.1.

Fig. 4 shows the Arrhenius relation (In weight deposited of silver against reciprocal absolute temperature, 1/T K), Activation energy ΔE as calculated amounts to 27.78 kJ.mol⁻¹. K and 27.220 kJ.mol⁻¹. K with silver and chromium respectively.



Fig. 4 the Arrhenius relation (in weight deposited vs 1/T, $K \times 10^{-4}$, pH 9.1.

Fig. 5 shows the cyclic Volta-monogram of Ag/C electrode in 0.1 M KOH and 0.1 KOH + 0.2 M ethanol, 0.5 Meth, 1.0 M ethanol at a scan rate of 5 mV s⁻¹. It can be seen that current density is kept more or less the same magnitude up to a scan rate value of 0.4 mV. With higher scan rate > 0.6 mV, the current density increases drastically and such increase becomes pronounced the general trend of the results indicate that the scan rate has no effect on the current density (I, mA/an²) up to 9 mV.





Increasing the scan rate > 9 mV and addition of ethyl alcohol to 1 M KOH alkaline electrolyte strongly increases the current density to about 10.4 mA/cm² with 2 M alcohol. It is worth noting that with higher alcohol up to 5 M has a pronounced decrease in the current density to 8 mA/cm² with + 1.0 V,



Fig.5 Cyclic Volta monograms of Ag/C electrode in 0.1 M KOH and 0.1 KOH + 0.2 Meth, 0.5 Meth, 1.0 Meth at a scan rate of 5 mV s⁻¹, pH 10

Fig. 6 shows the effect of scan rate on the pulse current value at a scan rate of 5 mV/s - 100 mV/s. It is seen that the early low scan rate from -0.6 up to +0.2 mV has no significant effect on the current density. With further increase of the scan rate, a marked increase of the current density takes place passing through a maxima with 0.5 mV and that effect is directly related to the scan rate.







Figure 7 shows the relationship of potential against current i E(mv)/i at a scan rate of 5 mV/s in alkaline medium as affected by addition of potassium hydroxide together with methyl alcohol. It can be seen that alkalinity suppress the change in pulse current (≤ 1 mV) with increase in potential up to 0.5mV. The current density value drastically increases (10 mA/cm²) with further increase in potential up to 0.8 mV.





5- Discussion

Electrodeposition implies the deposition of a solid metal from a solution of soluble molecules, ions or complexes by the action of electricity.

Because the electrodeposition process of silver nanoparticles is of special interest because nanoparticles may display a high decorative activity. The parameters determining the qualitative and quantitative deposition of silver on a graphite substrate has been literature (Yin et. al 2020). In that work, silver nanoparticles are deposited applying moderate current density from silver electrolyte. Results given in Fig. 3 proved that the deposition rate increases with increase of current density and temperature in a regular relation. The deposition process takes place in successive steps as follows.

a. silver Ionic radius amounts to 1.15 Ä (+1) (ChemGlob eriodic Table 2021) the metal.

Ion (available in the electrolyte) is firstly hydrated. The hydrate is defined as an inorganic salt containing water molecules combined in a definite ratio either bound to a metal center or have crystallized with the metal complex to $[M(H_2O)n]^{z+.}$





A model of hydrated metal $M^{\chi^+} + nH_2O \longrightarrow M(H_2O)^{\chi J \times +} \dots \dots (1)$

- b. under the potential difference between the positive and negative electrodes, the charged metal ions diffuse from the solution bulk to the cathode vicinity. Diffusion enhances with temperature rise.
- c. the diffusing ions then penetrate the boundary layer of the cathode and adhere to the charged cathode surface whereby it get reduced to a metal nanoparticle.

The regular relation given in Fig. 3 shows that step (b) is the rate-determining step. Fig. 5 supports this assumption. The rate of deposition is low within the early period of deposition and increases up to 6 min to 9 min. With time > 9 min, the rate of deposition decreases on the bases that the ions concentration in the electrolyte gradually deplete despite stirring. Fig. 4 shows the Arrhenius plot of the electrodeposition process with silver. The computed ΔE value amounts to 27.78 kJ.mol⁻¹.K and 27.220.kJ.mol⁻¹. with 12 mA/cm² and 16 mA/cm² respectively. The metal silver's reactivity may be proportional to the size and shape of the metal nanoparticles. With silver, the atomic volume is 10.28 cm³/mol [21].

Ionic silver is a solution consisting of water and silver ions (dissolved silver) containing no silver particles Ionic silver is up to 10^4 times more effective than colloidal silver. The ionic radius of silver is 1×10^{-12} meter (1×10^{-3} nm).

The regular relation holding the deposited weight and electrolyte concentration given in Fig. 2 shows that step (b) is the rate-determining step. Fig. 3 supports this assumption. The rate of deposition is low within the early period of deposition and increases after 6 min - 9 min. With time > 9 min, the rate of deposition begins decreasing on the bases that the ion concentration in the electrolyte gradually deplete despite stirring and for this reason the experimental electrodeposition cell is fitted with a separating funnel filled with a freshly prepared silver nitrate solution.



The tap of the funnel is accurately adjusted to compensate the continuous loss of the discharging silver ions and keep the electrolyte concentration at more or less constant value. Fig. 4 shows the Arrhenius plot of the electrodeposition process with silver. The computed ΔE value amounts to 27.78 kJ.mol⁻¹.K. That shows that silver is reactive metal ions. The reactivity seems to be proportional to the size and shape of the metal involved. With silver, the atomic volume is 10.28 cm³/mol (SchoolMyKids.com 2021). In this context, the current density directly relates to the amount of the deposited metal. That proposal is because current supply of electrons to the electrolyte via the cathode surface would increase in the potential and enhance step (b) to take place. Addition of alcohol to the metal ions will squash the deposition process. Fig. 9 shows image of SEM of the deposited silver (a), silver with alcohol at 12 mA/cm² (b) and 16 mA/cm² (c)



Fig. 8 (a) Ag, 12 mA/cm² Fig. 8 (b), Ag + alcohol Fig. 8 (c) Ag 16 mA/cm Fig/ 8 SEM images of deposdited silver

Fig. 9 shows the XRD of the deposited silver nanoparticles by pulse current.

Sharp peaks of the XRD pattern, appeared at 2θ of 28, 34, 38, 48, explore the material is crystalline. Whereby the peaks are distinctive to silver. Fig. 10 shows the FT-IR of silver.



Fig. 9 XRD pattern of the silver nanoparticles deposited by pulse current.

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495





Fig. 10 a FT-IR of silver nanoparticles

6- Conclusion

Electrodeposition of silver nanoparticles exhibit a wide scope of applications in the fields of energy, environmental, and medical technologies because of its unique properties determined primarily by their size, composition, and structure. Silver nanoparticles have been of interest because of their unusual and fascinating properties. The electrolyte conditions are nitrate solution with low concentration controlled by the addition of potassium nitrate and potassium cyanide as a stabilizer. The electrolyte was a 0.01 M solution of pure silver nitrate using an electrolyzing cell. EDC with current density up to 20 mA/cm2 and 15 mV and pulse current showed that silver deposited at a rate of 0.515 mg/cm²/min with 12 mA /cm2 and decreases to 0.21 and 0.16 mg/cm2.min with the decrease of current density to 6 and 5 mA/cm2 respectively. A mechanism of deposition postulates that such mechanism is a multi-sequence process. Silver deposited in reference to the discharge potential of silver is low (0.38 mV) as compared to other metals (e.g. 0.82 mV with chromium). Pulse current controls silver deposition due to flexibility in controlling one or more of the deposition-steps involved. The optimum electrodeposition conditions for silver in nano size are current density= 6 Adm⁻², pH 9.1, silver concentration 0.04 N, pulse ton = t, off = 1 at room temperature. Nanoparticles of silver deposited successfully on graphite substrate and their catalytic activity increases when porous graphite demonstrated as a substrate. Pulse current helps to deposit silver in nano-size particles from silver nitrate at alkaline pH value.



7- Conflict of Interest

We here confirm

- The *authors have participated* in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article and (c) approval of the final version.
- o *This manuscript* has not been submitted to, nor is under review at, another journal or other publishing venue.
- o *The authors have no affiliation* with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript
- o *The following authors have affiliations with CMRDI organization* with direct or indirect financial interest in the subject matter discussed in the manuscript:
- o The submission has no financial interest from anywhere. No funds or other support was received. The authors have no relevant financial or non-financial interest to disclose. The authors certify that they have no conflict of interest that are relevant to the content of the submitted article and they have no affiliations with in any organization or involvement in the subject matter or any material discussed in this article.

8- Reference

Sun, W. Chen G. and Zheng, L. (2008) Electroless deposition of silver particles on graphite nanosheets <u>Scripta Materialia</u> 59(10), November 2008, 1031-1034

Riccardis, M. D. Graphite Appl. Surf. Sci., 252 (2006), p. 5403

Yoshinaga, H. Takahashi, K. Yamamoto, A. Muramatsu, T. MorikawaJ. Colloid Interf. Sci., 309 (2007), p. 149.

Luo, K. Shi, N. L. Cong, H.T. and Sun, C. (2006) J. Solid State Electron., 10 (2006), p. 1003.



Srikanth C. K. Jeevanandam, J. (2009) "Electroless deposition of silver on synthesized calcite via surface modification" Applied Surface Science <u>255(16)</u>, 30 May 2009, 7153-7157

Tang Sh., Tang Yu., Gao F., Liu Zh. and Meng Xi (2007) "Ultrasonic electro-deposition of silver nanoparticles on dielectric silica spheres" <u>Nanotechnology Volume 18 Number 29</u> doi:10.1088/0957-4484/18/29/295607

Sondi, D.V and. Goia, E. (2003) Matijevć, J. Colloid Interface Sci. 260, 75

Rabah, M.A. (2013) "Preparation of size controlled silver nanoparticles from E-waste by electrokinetic and chemical and electrokinetic processes", International J. Chemical materials Science and Engineering, 7 (8), 75-80

Mandich N.V. (2021) "Chemistry & Theory of Chromium Deposition: Part I – Chemistry" Plating and surfac e finishing,

Wang, D., Song, C., Hu Z. and Zhou X. (2005) Synthesis of silver nanoparticles with flakelike shapes". Materials letters, Vol. 59(14-15)1760-1763,

Cuenya, B/R. (2010) Synthesis and catalytic properties of metal nanoparticles: size, shape, support, composition, and oxidation state effects Thin Solid Films, 518 pp. 3127–3150.

Orináková[,] R., Škantárová, L., Orinák, A., Kupková D.J. and Andersson J. T., (2013) "Electrochemical deposition of SERS active nanostructured silver films", *Int. J. Electrochem. Sci.*, 8, 80 – 99.

Samanta S., Agarwal Sh. KishoreNair K., Richard A, Harris A and Swart H. (2019) "Biomolecular assisted synthesis and mechanism of silver and gold nanoparticles" Materials Research Express, <u>Volume 6</u>, (8)

Cao B. J., Li; Z. Zhong-Dong C., Hai-Yan H., Xiang X., Li, W. and Gao-Rong H. (2014) "Electrodeposition of silver nanoparticle arrays on ITO coated glass and their application as reproducible surface-enhanced Raman scattering substrate" Applied Surface Science, Volume 258, Issue 5, p. 1831-1835.



Pilone D. and Kelsall G.H., (2006) "Prediction and measurement of multi-metal electro deposition rates and efficiencies in aqueous acidic chloride media", Electrochim. Acta, 5, 3802–3808,

Song, X. P. Gunawan, R. Jiang, S. Leong S.J., Wang, K. and Xu R., (2011) "Surface activated graphite nanospheres for fast adsorption of silver ions from aqueous solutions, J. Hazard. Mater. Vol., 194, 162-168,

Sun, Y and Xia Y. (2002) "Shape-controlled synthesis of gold and silver nanoparticles" Science, 298 pp. 2176–2179,.

Zhu J. Liu S., Palchik O., Koltypin Y., and Gedanken A. (2000) "Shape-Controlled Synthesis of Silver Nanoparticles by Pulse Sonoelectrochemical Methods", Langmuir, 16, 6396-6399

Yin D., Liu Y., Chen P., Meng G., Huang G., Cai, 1 L. and Zhang L., (2020) "Controllable Synthesis of Silver Nanoparticles by the Pulsed Electrochemical Deposition in a Forced circulation Reactor" Int. J. Electrochem. Sci., 15 (2020) 3469 – 3478, doi: 10.20964/2020.04.57

ChemGlob eriodic Table of the Elements, Physucal data. Internet (2021_.

SchoolMyKids.com (2021) "Periodic Table Element Comparison: Compare Elements - Silver vs Chromium" 2021 internet.

Copyright © 2022 Prof. Dr. Mahmoud A. Rabah, Prof. Dr. Nabil Nassif Girgis, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC)

Doi: https://doi.org/10.52132/Ajrsp.e.2022.33.1



The Impact of Resistance to Change on the Implementation of Quality Management System in the Ministry of Education (General Directorate of Education in South Batinah Governorate as a Model)

Mr. Hamed Salim Said AL Basami

Master of Business Administration, Ministry of Education, Oman Email: <u>hbasamii@gmail.com</u>

Abstract:

This study is investigating the reality of resistance to change in the light of Quality Management System (QMS) implementation in the Ministry of Education (South Batinah Directorate as a model of the study). It tries to answer some questions related to the main factors that lead to resistance to change with correlations of gender, years of experience and educational level. The method of collecting data of this study was conducting quantitatively through an electronic questionnaire including 59 participants of directors in different administrative level. The data has been analyzed statistically through SPSS. The result shows that the performance of the employees was impacted through the lack of awareness of the QMS requirements. Although, the all four factors recorded close level of resistance, the cognitive rigidity factor recorded the highest factor that lead to resistance to change. The study results can be generalized to other directorates in the Ministry of Education because the similar work environment. This study can be used to make some very crucial amendments in the future in managing QMS in the organization.

Keywords: Quality Management, Change management, Resistance to change, Quality Management system



ملخص الدراسة

تبحث هذه الدراسة في واقع مقاومة التغيير في ضوء تطبيق نظام إدارة الجودة (QMS) في وزارة التربية والتعليم (مديرية جنوب الباطنة نموذجاً). بحيث تحاول الدراسة الإجابة على بعض الأسئلة المتعلقة بالعوامل الرئيسية التي تؤدي إلى مقاومة التغيير ضمن متغيرات الجنس وسنوات الخبرة والمستوى التعليمي. واعتمدت الدراسة طريقة جمع البيانات الكمية من خلال استبيان شمل 59 مشاركاً من المدراء ورؤساء الأقسام في مختلف المستويات الإدارية. وتم تحليل البيانات إحصائياً من خلال برنامج .SPSS ، حيث أظهرت النتيجة أن أداء الموظفين قد تأثر من خلال تدني مستوى الوعي بمتطلبات تطبيق نظام إدارة المعرفي سجل أعلى ممن أن جميع العوامل الأربعة سجلت مستوى قريبًا من المقاومة ، إلا أن عامل الصلابة المعرفية والثبات المعرفي سجل أعلى مستوى من بين بقية العوامل التي أدت إلى نشوء مقاومة التغيير في حال التعامل مع مستجدات العمل المعرفي سجل أعلى مستوى من بين بقية العوامل التي أدت إلى نشوء مقاومة التغيير في حال التعامل مع مستجدات العمل المعرفي سجل أعلى مستوى من بين بقية العوامل التي أدت إلى نشوء مقاومة التغيير في حال التعامل مع مستجدات العمل المعرفي سجل أعلى مستوى من بين بقية العوامل التي أدت إلى نشوء مقاومة التغيير في حال التعامل مع مستجدات العمل المعرفي البيئة العمل المماثلة من حيث ثقافة المؤسسة والأئر الاجتماعي والنفسي وكذلك المنظومة الإدارية. كذلك فإن نتائج الدراسة يمكن تعميمها على المديريات الأخرى في وزارة التربية والتعليم نظرا لبيئة العمل المماثلة من حيث ثقافة المؤسسة والأئر الاجتماعي والنفسي وكذلك المنظومة الإدارية. كذلك فإن نتائج الدراسة يمكن استخدامها لإجراء بعض التعديلات الحاسمة والجوهرية في المستقبل وإدخالها على مسار ال إدارة تطبيق نظام إدارة الجودة في المؤسسة التربوية.

الكلمات المفتاحية: إدارة الجودة، إدارة التغيير، مقاومة التغيير، نظام إدارة الجودة

1. Introduction

The application of quality management is one of the main adoptions in quality management principles, methodologies and act as tools in the educational system. The concept of quality management is derived from the industry and equally helpful for educational institutions and systems to gain competitive advantage (Pratasavitskaya and Stensaker, 2010). In some cases, this is argued to have no connections with educational institutions but in the last two decades this topic has gained substantial attention from researchers. The outcomes of such researches have established quality management practices as vital for organizational sustainability and competitive advantage (UNESCO, 1998).

Quality as a heart of education has the ability to impact the outcomes of an educational institution. Almost all the developing countries are struggling to ensure that students achieve learning outcomes through acquiring values and skills. The knowledge acquisition helps them to become valuable citizens who can actively take part in nation-building. Therefore quality management in education is an integral part of the policies in many of the countries.



The policies of the government of Oman related to the improvement in education imply that the government recognizes that the overall education system does not match with global Quality standards. Based on this justification increased focus on the quality of the educational institutions and overall system has been encouraged. Traditionally, institutions are assumed to maintain quality by their internal resources under a broad clarification and objectives of improving institutions and educational process. Education has to be about quality and excellence rather than the quality of shared time with students, teachers, systems, and stakeholders. The system of quality entails a process of activities for the administration of an institution under certain procedures and evaluation models. In many countries the issue of quality management has been an education for the masses is under the policy of high accountability in order to maintain the desired level of achievement of learning through the education system of that country (Becket and Brookes, 2008).

The overall governance structure, enrolment rates, and changing needs of outcomes of education put forth the emphasis on the existence of a quality management system. The process of quality management in educational institutions has defined new roles and functions, technical, and managerial engagements. Therefore, having a quality management evaluation process and mechanism has a vital role in assessing the function of education institutions by multi-dimensional approach (Yusof & Aspinwall, 2001).

Middle East educational system is now encountering numerous changes in different ranges of life that requires corporate and private organizations to alter their conventional organization and administration styles. In this way, it is required that each organization embrace cutting edge administration concepts in the event that they crave to realize their destinations more promptly. These changes will increase their competitive edge within the worldwide inter-institutional efficiency and quick innovative improvement within the world in different regions, particularly in communication and teaching learning technologies. Improving the performance of educational institutions has become a worldwide concern in all nations within the world. Among the foremost imperative characteristics that recognize GCC countries, is their focus on economic development through long term economic plans. Thus education has been given among top priorities in developing the human capital.



Hence, quality management in educational institutions need the participation of employees and governing bodies in order to ensure the achievements of outcomes (Al- Khatib, 2011).

This research is conducted to find out the effects of resistance to change on the implementation of Quality Management System in the Ministry of Education in Oman, (General Directorate of Education in South Batinah Governorate as a model). The literature review will be conducted to discuss the topic in detail and the researcher will identify the methodologies that he will use in this research. Different methods of data collection and recommendations will also be discussed to find out the answers of the research in detail (Alhaqbani, 2016).

Quality management systems are actually coordinated activities that help to produce specified and desired results. Customer needs can be fulfilled easily by adopting these procedures very carefully. The focus of every organization is to satisfy its customer needs which are the basic and most important parts of every organization in the short and long run both (Andrade, 2017).

During the previous two decades, researchers have reported many factors contributing to raising concerns over the quality management of the educational institutions. The new urgencies of change in educational management have pushed learning to the emergence of quality management (Cardoso, 2010). Quality management systems are actually coordinated activities that help to produce specified and desired results. Customer needs can be fulfilled easily by adopting these procedures very carefully. The focus of every organization is to satisfy its customer needs which are the basic and most important parts of every organization in the short and long run both (Andrade, 2017).

1.2. Statement of the Problem

Many natural factors and forces are exerting pressure for adopting change management in the educational system of nations in order to improve the outcomes of learning. Such changes have led to a greater transformation in educational management and this drive has emerged as part of long term plans of the countries. The dynamics of the quality management system have changed the organizational administrative philosophy. Therefore, this has been attempted inside the national policy setting despite the truth that education is progressively in evolution globally. In the context of Oman,



This study questions what facts relate to current approaches to quality administration in educational institutions. Ali *et al.*(2015) uncovered some dimensions of the concept that add up to quality administration and the communication with education institutions in Oman. The implementation of quality management relies on directors, staff, and their staff where they have become preparing programs within a regulatory framework.

According to a research of the Ministry of Education in Oman reported by Wyatt & Atkins (2009), "the educational research in Oman encountered by the challenges of conducting investigate at a remove, a few of the authors in this volume were exceptionally creative, and actual". Therefore, the current endeavor merits research on this topic to investigate the realities of change implementation and resistance to it.

Therefore, research evidence on educational institutions in Oman provides the rationale of this research that underpins the usage of quality management concepts in Omani educational institutions at the school level. The obvious outcomes of the research will enlighten the meaning of quality management, factors of resistance to this change and their impact on quality management in *(GDOE)* in South Batinah in Oman.

1.3. Research context

Sultanate of Oman is a member of the Gulf Cooperation Council "(*United Arab Emirates, Saudi Arabia, Kuwait, Oman Qatar, and Bahrain*)". The education system of the country was established formally during the decades of the 1970s and the 1980s. In 1997, the Ministry of education announced its reforms programs to gradually replace the education system and organized basic education into two cycles. The first cycle grades 1 to 4 and the second cycle grades 5 to 10 followed by two years of post-basic education secondary education, grades 11 and 12 (Ministry of Education, 2004). Issan and Nariman (2010) categorized the beginning of the first stage in 1970, for rapid development of education both qualitative and quantitative. The second stage started in the 1980s with a focus on the quality and the third stage started in 1995, under "Vision of Oman's economy 2020". Further, the strategic plan (2001) was introduced to restructure the secondary education system to ensure that students will be adequately prepared for the requirements of higher education and the labor market.



Eleven regional directorates of education "(*Muscat, Batinah North, Batinah South, Dakhliyah, Sharqiah South, Sharqiah North, Dhahirah, Al Buraimi, Musandam, Al Wusta, and Dhofar*)" comprise the entire structure of administrative shape of the schools' education system in Oman. Each directorate is authorized to administer and manage education in the region under the supervision of the Ministry of Education. The government has always shown firm commitment for improvement by quality management system (QMS) as a means toward producing the quality of education and administration of schools. The suitability of education is one of the main concerns to cater to needs of youth and employment entities by developing teamwork, presentation skills, problem-solving, and critical thinking (Ministry of Education and World Bank, 2012).

The post 2010 period experienced substantive activity within the advancement of educating, creation of official bodies, and instructing collaborative efforts for the improvement of education. Progressively, schools were given the independence to run their preparing programs, and this included the advancement of educational modules, collaborative activities that draw on their claim capacity of nearby educator learners, and preparing programs. Schools were brought in line with national and key activities, and general activity focused on self-sufficiency activities through quality management (Nasser, 2019).

1.4. Research Questions

The research intends to answer the following questions in measuring the resistance to the implementation of Quality Management System (QMS) in the General Directorate of Education (GDOE) of South Batinah in Oman.

RQ1: What is the level of resistance to Implementation of Quality Management System (QMS) in the (MOE) based on staff and directors' perceptions?

RQ2: What are the factors that account higher to resistance to change?

- **RQ3:** Is there any significant difference in opinion regarding resistance to Implementation of Quality Management System (QMS) in the (MOE) according to years of experience?
- **RQ4:** Is there any significant difference in the opinion regarding resistance to Implementation of Quality Management System (QMS) in the (MOE) of South Batinah according to educational level?



1.5. Research objectives:

The main objective of this study is to investigate the current reality of resistance to change in Implementation of the Quality Management System (QMS) in the General Directorate of Education (GDOE) of South Batinah in Oman. The specific objectives of the research are as follows:

- 1. To assess the level of resistance to Implementation of Quality Management System (QMS) in the (*MOE*) by directors and staff perceptions.
- 2. To find out the factors of resistance that account higher to resistance and make recommendations to overcome the issue of resistance
- 3. To investigate the significant difference in the opinion regarding resistance to the implementation of Quality Management System (QMS)based on years of experiences.
- 4. To investigate the significant difference in opinion regarding resistance to Implementation of Quality Management System (QMS) according to years of educational level.

1.6. Significance of the Study

Quality management in educational administration is gotten a significant consideration from the regulatory administration and scholarly analysts. This research is significant in the following ways.

- Distinctive opinions are there about the plausibility of selection in higher instruction teach between a few higher instructive teach in Oman, and a few investigates and thinks about around, it still fair to address a topic that has not gotten proper way for the correct and compelling application.
- The research will explore the facts related to changes in school administration approaches over time after quality management drive in Oman., which will reflect proficient quality management in the (MOE) in Oman.
- The research will provide a valuable theoretical contribution to further research in this area of study. Therefore, the exceptionally reason for conducting this research is to assist educational institutions to actualize quality management concept, that's when connected, with solid administrative support. The outcomes of research might be leading in guiding a continuous development in the administration framework and figure out the impact of resistance on the Quality Management System.



- The research will be helpful for policy-makers to evaluate their regulatory and policy frameworks to improve the assurance of quality system.
- Finally, the research is not a remote but active research that will utilize field study in the real context of the phenomenon under the study.

1.7. Scope of the Research

The current study has investigated the impact of resistance to change on implementing a quality management system (QMS) by the Ministry of Education specifically in General Directorate of Education (GDOE) in South Batinah in Oman. The field study of this research is applicable to GDOE only. The study has tried to cover as much as possible participants from the South Batinah governorate in a convenient way. Therefore, as an outcome of the study cannot be generalized the results other than the context of Oman but closely related to other studies in a similar topic.

1.8. Definitions

• Quality Management

Quality management is a process that oversees all activities and tasks needed to maintain the excellence of an organization. The main task is to determine a quality policy, creating and implementing quality planning. Finally, assurance through quality control and quality improvement following the organizational process (Sallis, 2014).

• Change management

Change management is known as the organizational process, tools and techniques to manage institutional functioning. One side of the change management is the people side of change that focuses on the people impacted by the change. Other side is processes, systems, organization structures and roles along with technical tools (Todnem, 2005).

• Resistance to change

Resistance to change is the attitude of individuals. This refers to certain actions taken by individuals and groups that hinder the implementation of change because people perceive change as a threat to them (Todnem, 2005).

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



• Quality Management system

The quality management system (QMS) contains policies, processes and procedures. These procedures are essential for the execution through deployment in the core of functional areas of an organization to assure the achievement of desired outcomes (Sallis, 2014).

2. Literature Review

2.1. Change Management

Change management is the process, tools and techniques to manage the people in order to make business functions smoother. Change management has a focus on the people that may impact the change. Any type of changing in systems, processes, organization structures and/or job roles will focus on two types; technical side and employee side. The main function of the change management process is to make ensure, that standards and procedures set by the company are used for efficient and prompt handling of all changes, to reduce the possible impact of changerelated experiences upon consequently improve the day-to-day operations of the organization and on service quality (Anderson, & Anderson, 2010). Components or tools of change management are: Communication and communication planning, Readiness assessments, sponsor roadmaps, Sponsor activities, and management training for change management. Basically, there are three different types of change management: transitional, developmental, and transformational. It is very much essential to identify these. As different kinds of changes are required for different plans and strategies; in order to gain engagement, ease acceptance and reduce resistance (Cameron & Green, 2019). Although evidence suggests that many of the business process reengineering programs have been failed, because of less alignment with corporate levelstrategy. Significant changes should be strengthened by findings and results. Individual plans with quantifiable outcomes need to enforce for expected desire results. Employees who meet their targets should be remunerated properly and those that don't have to confront results (Sikdar and Payyazhi, 2014).

2.2. Change Management in Educational Institutions

Change management in educational institutions is a philosophy along with certain procedures. Otherwise, there are as of now a few cases that account for the applicable regulation. Quality appraisal models coordinate see on maintaining quality system through administration, driving



to persistent quality change. The available models of quality management propose to survey education as a whole, counting not as it were its instructing and investigate models, but moreover other exercises, and, excellently, organization administration (Sarrico et al., 2010). A comprehensive transformation is led by a change in the organization. This transformation has social, economic and cultural aspects. Regarding a specific culture and structure of the organization, the transformation is from traditional to the modern approach. The use of new managerial approaches, methods and resources provides bases for new roles of people as well. In the education sector, the ultimate destination of change management is to achieve predefined outcomes of learning of students and organizational governance and administration. Therefore, change management in education works on three level outputs (i.e. student's learning outcomes, governance, and administration of institutions). Change process proceeds towards outcome through means and creates challenges (Alibabić, 2010)

Numbers of educational systems have tried quality administration models initially created for the educational sector. A key advantage of all the models is to embrace a key approach to quality assessment and administration. The entire model of quality management is measurement, assessment and outcome-based. When this becomes a question of management, this tends to figure out the ways to be implemented. Mostly such approaches are closely linked with the work of organizations and institutions that are changing. The process of change with its implementation is the influence of the environment, or by the auditing bodies (Pratasavitskaya and Stensaker, 2010).

The inherent difficulty in quantifying theeducation for self–assessment purposes is approach increased focus on the administrative aspect for implementation. At the phase of the assessment of the outputs, the applicability of quality implementation models comes up with their shortcomings and pitfalls. The main outcome product of the educational system is the learning of students which is believed to be neglected in many cases. Quality control management should give attention to the student learning experience which is the main focal point in fact.

2.3. Organizational changing pressures

The ever-changing expectations of stakeholders and patterns of institutions globally demand change.



The turbulent outside environment and energetic inner environment are similarly true blue strengths for instructive organizations as well due to the reality non-profit businesses (schools) also experiencing innovative, basic, financial and social adjustments rather like the case (Levin, 1993). Furthermore, data sharing since of globalization, and verbal trade innovation, statistic changes drastically powers individuals to trade appropriately (Ragsdell, 2000).

Really a few basic outside triggers started out of entryways the organization many be positioned as control as approaches of the government, prerequisites and values, statistics characteristics. Another issue is social and political weights made by dominant political and social occasions for the competitiveness of educating (Dawson, 2003; Kreitner & Kinicki, 2010). The encountering forces may be internal or external as internal factors that belong to the inner body of the organization and encourages organizational proposed change. Leavitt (1964) proposed these forces as following.

- 1. Technology (. technology and tools to assist the process)
- 2. Basis functions (important tasks of organizational operations)
- 3. People (human resources of the organization)
- 4. Administrative structures (lines of communication, hierarchy, reporting pattern, rewards, style of leadership and disciplinary procedures).

Therefore, both human resources and behavior of management can be regarded as key factors in change management (Kreitner &Kinicki, 2010).

2.4. Change and Leadership

This shows the relationships between the change types and methods in management and how this relationship can affect the change outcomes (Serina Al-Haddad Timothy Kotnour, 2015). Simply change management is a fuel to inject more power in business. The management and elected people have verified time to time that effective change management and leadership significantly influence the successful implementation rates of organizational initiatives/projects (Hornstein, (2015). AnderVoet, Groeneveld, and Kuipers (2014) differentiating leadership activities of planning and developing processes of change. Since change leadership is related to the higher leaps, that we need to make, related to propitious chances.



2.5. Counter resistance in change

There are a number of approaches explaining resistance to change, which can be countered and make it simple to execute the change process. The strategies of neutralizing resistance to modify aren't constantly powerful but educative and persuasive. The entire idea of managing the resistance is standing up to change is made to get it the advantages of this adjust and the blessings that they and the overall organization could have whilst the proposed adjustments are executed (Fullan, 2001). These methods incorporate; practice and communication, help and inclusion, transaction and incorporation, manage as unambiguous in addition to understood impelling (Wagner, 1998).In order to understand the common sense backing resistance to exchange performed in academic organizations, it is crucial to think about the variety of resistance such as blind, political or ideological (Hambrick and Cannell 1989; as cited in Burke, 2008).

Higher management creates a more suitable environment in order to support the organizational individuals. For occurrence, it might create the staff members by creating a difference in their procedure for more aptitudes that are important and fundamental in implementing the changes, especially at the danger zone. Such practices are probably going to diminish protection from change (Dessler, 2001).

In arrange to form beyond any doubt that a change will be effective, school pioneers chose to be much specific on the people who are assumed to urge data, how much data, the exactness of that data, and when to spread the data (Fullan, 2007). Moreover, resistance to change may be diminished by giving the pioneers of standing up to bunch the most parts in choice-making approximately the change. This will offer assistance in recognizing their sees and making beyond any doubt that they propose something which they cannot stand up to (Bush & Middlewood, 2005).

2.6. Types of Resistance

Education belongs to the service sector and entirely based on the number of students enrolled, and any of the other businesses can be satisfied or not depending on their priorities. Higher education is just like another formal education level in contrast to the social aspect. Nowadays it is often happening that institutes are effecting badly and suffering huge amount of challenges, problems and threats which are aroused from different internal and external variables that have the ability to change the shape of the business and set new dimensions for institutes,



which entirely based on technological, IT and scientific development, and they introduce different comprehensive and skilled programs for modernization and development in the students that are enrolled in Arab education institutions. These steps are initiated in order to overcome the problem and weaknesses of institutes. Resistance to change (Lewis, 2019) may be of different types such as;

- Confusion resistance
- Political resistance
- Ideological resistance

2.7. Causes of resistance to change

In reality the resistance to accept change may take numerous shapes, it is difficult to recognize the reasons behind the resistance. The qualities against this change in the working environment consolidate ignoring the prerequisites and needs of the organization people; giving insufficient information around the nature of modifies and not recognizing the requirement for modify. In this way, people may appear fear and uneasiness over such things as security work, work levels, a mishap of work fulfillment, particular wage rates, confrontation of individual control over work and the changes occurring in the working environment (Mullins, 2005). In spite of the truth that modifies is actualized for positive reasons like changing to the unsuitable environment and remaining competitive, People belongs to the organization usually react to modify activities oppositely and stand up to change (Boohene & Williams, 2012). The primary fact of this research is the negative reaction caused by weight, extend and flimsiness coming with change as following.

- Interference with need fulfillment
- Selective perception
- Habit
- •Inconvenience or misfortune of freedom
- •*Fear of the unknown*
- •Knowledge and expertise obsolescence
- •Organizational structure



In organizations which have flawless management with progression of the specialist; work division and, directions, specializations and rules, a very less amount of structure are being given to bunch for satisfying the organizational goals.

2.8. Overcoming resistance to change

Critical factors include the project scope, size, and as well as personnel hierarchical position and experience levels (Canning & Found,2015; Shimoni, 2017). There are nine change management factors that contribute to minimizing resistance to change,

- 1. Need to communicate a clear vision and mission to the management.
- 2. Top level management should need to lead this change.
- 3. Modify only appropriate elements of the organizational hierarchy.
- 4. Remove all the hurdles in communication between different departments.
- 5. Effective changes are required for individuals to accomplish missions.
- 6. Change and modify management performance measures and their tasks.
- 7. Set always new goals by comparing them in previous tasks.
- 8. Arrange training sessions
- 9. Adequate supply chain and resources

Resistance to change is the most critical phenomenon that should be addressed by the companies. Once management will identify the problems, the use of appropriate strategies and policies can reduce the resistance (Lines & Mischung, 2015). These issues shape the extent of resistance to change which translates from the perception of, commitment to and involvement in the change process (Alkawaz & Rehman, 2018).

Indeed, in spite of the fact that changes in an organization are supposed to modify in innovation, progression or in structures within the organization, it is apparent that change has colossal effect on people within an institute. In any case, the cause why numerous institutes fall flat to achieve change activities is related to thinking little of the impact of change on the person (Ashkanasy & Kavanagh, 2006). Subsequently, dismissing mental recognitions of workers; lead toward disappointment of change activities in institutes (Buelens, Devos & Bouckenooghe, 2007). In spite of the fact that, for fruitful change usage, it is vital to oversee the mental move of representatives viably (Martin & Callan, 2005).



It is important to feel that viable administration of changes entirely depending on understanding of humans in clear sense, conducted within the organization. Due to challenges and problems of these changes, people may respond with a few feelings like instability, disappointment

2.9. Change benefits

Change management is also a way to minimize resistance to change. Change as an organizational improvement enhances the morale, productivity and quality of work. The change also supports cooperation, collaboration and communication among the employees of an organization. A well-planned methodology of change management reduces stress and anxiety and encourages loyalty among the employees of the organization. Change allows employees to learn new skills, explore new opportunities and exercise their creativity through increased commitment. Benefits of change management incorporate increased representative assurance, superior collaboration among divisions, bridging management-staff capacities, expanded quality from the client perspective and ceaseless improvement of each one who is the portion of higher education institutions (Al-Tarawneh, 2011). Quality in instruction may be or maybe a complex theme. What makes it such as the number of the parties included as well as the escalation of changes in advanced life.

2.10. Behavioral Factors of Resistance to Change

There have been discussed many reasons in the previous literature related to change management. The evidence about the factors of resistance is from different contexts and situations. However the researchers (Carlon et al., 2012: Jones, 2013; Goetsch, & Davis, 2014) in early literature has discussed several factors responsible for resistance to change as follows:

- Not understanding and misunderstanding why the change is necessary for the organization. It is very much obvious from those employees who believe that their current working practices are doing well.
- Fear of the unknown: This is a common reason for resistance .This is just a risk perception of unknown factors that remains as an ambiguity in the understanding of employees.



- Lack of competence: Personal incompetency is one of the reasons for resistance to change because people don't want to lose their position under the fear of being exposed as incompetent.
- Comfort with existing conditions: People become used to and comfortable with existing conditions and they have low trust in change. One of the common misperceptions is that the change process might be a temporary phenomenon.
- Poor participation: In many cases, this has been reported that people resist changing because they think that they have not been consulted. In this way, they have the sense of not having ownership and mistakenly they think change process as the agenda of some managers.
- Poor organizational leadership: Ineffective communication and absence of change leadership leads to weak change embracement. The role of leaders sometimes does not inculcate the real spirit of change in people. The main reason for this is poor communication and leader fails to connect people to an articulated vision and not able to connect employee's rewards with outcomes of change.

Oreg (2003) summarized the above factors to four main constructs and Al-Haddad & Kotnour(2015) and Witting (2012) examined employees' reactions to organizational change and classified the following factors of resistance to change.

1. Routine Seeking

Routine seeking (RS) is an individual behavior of being staying in a state of existence for the long term. This is one of the effective components of resistance behavior because people are not ready for the short-term inconveniences" associated with change

2. Emotional Reaction

An Emotional Response to change as resistance is a situation mainly given to influence other individuals, groups or entities. Emotional Response is a variant of this spectra of emotions, Plutchik (1983) has proposed eight main emotional dimensions such as happiness vs. sadness, anger vs. fear, trust vs. disgust, and surprise vs. anticipation. These emotions can then be combined to create others (such as happiness + anticipation = excitement).
Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



3. Short-term thinking

Short –term thinking is a kind of permanent resistor. A short-term focus represents the degree to which the staff of an organization is preoccupied with short-term challenges. They are not aware of the reality of short-term objectives compared to long-term benefits of the change. Finkelstein et al. (1995) conducted a meta-analytical study on how employees are typically associated with short –term focused. He revealed that the lower potential for development compels them to stick with such thinking. The short-term focused employees may not relate themselves to more drive and readiness for change initiatives.

4. Cognitive rigidity

Cognitively relates to the act or process of knowing, and perceiving. The cognitive function, development and learning ae relating to the mental processes of perception, memory, judgment, and reasoning, as contrasted with emotional and volitional processes. According to Oreg (2003), the cognitive rigidity cognitive rigidity as a construct of resistance behavior represents reluctance to consider and test new perspectives and concepts. Change accepting behavior remains more cognitively and emotionally open to change initiatives taken by the management.

Conclusion

Change management is an emerging process phenomenon in many of the organizations globally. Change management is driven by many elements and results as the initiatives of the management. There are agreed benefits and advantages of change management for organizations and employees as well. At the same time, the change management process is experiencing some of the challenges. One of the major challenges is resistance to change management. This resistance is at the policy level, structural and behavioral level. The literature of common factors of resistance to change accounts for certain factors as main obstacles to the way of change. The literature review proposes the independent variables constructs such as, routine seeking attitude, emotional reaction, short term objectives, and cognitive rigidity. The dynamic nature of readiness for change is confronted by some of the key challenges in public sector organizations is quality administration. In many of the organizations this not administration approach effectively connected to the particular theme of quality management. The main contributor to the resistance factors is the scholastic culture of these organizations.



The literature on factors of resistance provides the theoretical and conceptual guidelines for the current research. The main construct of resistance to change are taken as independent variables on the evidence from the literature.

3. Research Methodology

3.1. Research approach:

In order to determine the way of dealing with the current research, a deductive and inductive research approaches is used by the researcher to find out the results. These research approaches are very effective and can be easily used to carry out further tasks.

In this research study, the researcher has used inductive research approach which is not costly and give reliable results. Data is collected through different resources which is trustworthy. The random population also gives their recommendations to improve the processes as well (Pheng, 1997). The outcomes of this approach enable the researcher to make generalizations from specific (sample) to general (population).

3.2. Research methodology

There are so many findings that are based entirely on the actions of the researcher and they also depict the authenticity and reliability of the collected data. Research strategies are also helpful for the respondents so that authenticity and reliability could be maintained (Pheng, 1997). The research methodology is the particular or methods utilized to distinguish, select, prepare, and analyze data around a point. In a term paper, the strategy area permits the researchers to fundamentally assess a study's in general legitimacy and unwavering quality. Methodology refers to the study of how research is done and entails how we find out about procedures, and the manner of a research endeavor. This also outlines the principles that guide research practices. (Saunders, Lewis& Thornhill, 2012). There is many research methodologies which can be used to find out the required results of the research. Research methodologies that could be used:

- Descriptive method.
- Experimental method.
- Exploratory method.



In this particular research, the researcher has used descriptive method to find out the relevant results and this method is easy as compared to others. This research well described the characteristic of the sample and data. Furthermore, this is capable to describe the state of existence of variables and their relationship. In the second phase hypotheses are tested based on the co-relational phenomenon.

The quantitative research strategy is considered to be suitable for the current research on the following grounds.

- Appropriate and flexible to generate models, theories and hypotheses based on the exploration of the phenomenon.
- Collection of imperial data from a field study.
- Good provision for the data modeling
- Use of statistical packages in the analysis of data.
- Experimental control during the inquiry
- Manipulation of variables related to objectivity
- Instrument development for data collection.
- Prepare an appropriate measurement model suitable to answer to the research questions.

3.3. Data Collection approach

3.3.1 Sampling:

The target population is situated in a specific geographic concentration in Oman. In the current scenario, convenience samples are the most suitable method of drawing samples from the target population. One of the main advantages of this sampling is that sample represents the target population and eliminate sampling bias. The sample space is not large enough therefore a convenient sampling will be reasonable representative of the population. In a kind of basic study his method is reasonably good to get primary data.

3.3.2 Population:

The targeted population is the administrative staff and directors of departments in the Ministry of Education in Oman.



3.3.3 Sample size:

Sample size refers to the number of observations and data units derived from a population. The size of the sample has impact on the significance of the results. Larger sample size refers to higher reliability. In the current case study, the sample is restricted in the General Directorate of Education in South Batinah Governorate, which has 9 main departments to administer the educational institutions in the area. The sample selection will be as follows:

| No | Departments | Number of directors and assistants | Number of heads of sections | The total targeted sample (each department) |
|-----------|--|---|-----------------------------------|--|
| 1 | DG office | 2 | 8 | 10 |
| 2 | Financial Department | 1 | 4 | 5 |
| 3 | Administrative Affairs Department | 1 | 4 | 5 |
| 4 | Planning Department | 2 | 2 | 4 |
| 5 | Human resource development Department | 4 | 7 | 11 |
| 6 | Educational assessment Department | 3 | 3 | 6 |
| 7 | Educational Programs Department | 3 | 4 | 7 |
| 8 | Private School Department | 1 | 4 | 5 |
| 9 | Information Technology Department | 2 | 4 | 6 |
| 10 | Project and Maintenance Department | 1 | 3 | 4 |
| \square | Totals | 20 | 43 | 63 |
| \square | Grand total of sample | | 63 | |



3.4 Conceptual framework:

The current study is based of change theory of kotter & schlesinger (1989). The objective is to measure the level, reasons and significance of gender and experience on change resistance factors. Moreover, study examines the co-relational impact of resistance factors to implementation of the Quality Management System in the General Directorate of Education in South Batinah Governorate in Oman. The individual's perception plays an important role also play in the process of *change*. The reason creation of *resistance* is natural because perceived as a threat to one's security or ingrained habits loss of status or as fear of the unknown. Initially, this concept was developed by a (neck, 1996) that *change* will generate *resistance*. Therefore, based on assumptions of grounding theories and context of the research, the following research model is presented for current study

| | High | Factors | Significant | |
|---------------------------------|------|-----------------------|---|-----------|
| | | Routine Seeking | | |
| | | Emotional Reaction | Gender (Male/Female) Differen | nce |
| Factor Rank (Presence Level) | | Short-Term Thinking | Level of in Level Experience Resitan | of ice |
| - | • | Cognitive Rigidity | | |
| | Low | e | Not Significant | |
| | | Resistance to Changeo | change | |

(Research Model)

3.5. Development of Instrument

The measurement of change management varies from one organization to another based on the business process.



There are several studies guiding about the scale for measuring the change and effectiveness of change management. Measuring the effectiveness of change is a multi- dimensional spectrum. The measurement items for resistance to change in this study were adapted from Oreg et al. (2008) who examined the equivalency of the resistance to change (RTC) scale across undergraduate colleges from 17 countries. The factors of predictions identified by RTC scale are routine seeking, emotional reaction, short-term thinking, and cognitive rigidity. Table below shows the factors and main items of the scale used in the study:

| Factor | Indicators |
|---------------------------|---|
| | • Changes to be a negative thing. |
| B outing Seeking | Preference to routines |
| (Oreg et al 2008) | Unlinking to do new tasks |
| (010g 01 ull ,2000) | • Impact of new tasks on routine life |
| | • Boredom |
| | • Feeling of stress |
| | Tense attitude |
| Emotional Reaction | Unfair feeling about evaluation criterions |
| (Oreg et al. ,2008) | • Uncomfortable with new tasks. |
| | • Extra work without rewards |
| | Lack of Empathy |
| | • Changing a real hassle to me. |
| Short-Term Thinking | • Change has no potential to improve my life. |
| (Oreg et al2008) | Importance of immediate outcomes |
| (,,, | Personal benefits |
| | Change avoidance |
| | • I often change my mind. |
| Cognitive Rigidity | Situation does not motivate |
| (Oreg et al. ,2008) | • Not changing mind easily. |
| | Consistency of views |

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



| Factor | Indicators |
|----------------------|-------------------------------------|
| | Satisfaction of parents |
| Implementation of | Employee's management relationship. |
| change | • The role of change agents. |
| (Claver et al.,2003; | Productivity of staff has improved. |
| Wisner,1999) | Commitment of staff |
| | Quality of learning |

The major purpose of this study which pointed out through the questionnaire was to find out the main factor\factors that lead to resistance of change that influence the implementation of the Quality Management System in the Ministry of Education, by using specific direct and indirect statements. A 5-point rating scale has been used (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree).

3.5.1 Validity

The research instrument was reviewed by a group of specialists to investigate the external consistency of the items. Also the internal consistency statistically used to calculate the correlation coefficients between the items and overall mean of questionnaire. The coefficients of all items were significant at (α =0.01).

3.5.2 Reliability

Reliability level of the questionnaire was acceptable, (Cronbach's alpha=0.75) which indicates that we can use it.

3.6 Analysis tools

Following the data collection process, critically analyzed outcomes are essential for research. The data analysis is very important to provide an explanation of various concepts, theories, frameworks and methods used. Therefore, processing and manipulate data, analyze the relationships and correlations between data sets become easy through data analysis tools. Also, tools are helpful in identifying patterns and trends for interpretation. Initially, data was processed in MS Excel and PSPP (online free) software for analyzing descriptive and correlation data.



The results have been analyzed based on the descriptive statistics, ranking of factors, t-test and ANOVA.

3.7 Problems and limitations of approach

The research study has some limitations where the researcher took care of ethical issues. Ethics would be considered very strictly while conducting different surveys and interviews. It is the responsibility of the researcher to take care of the ethical implications and management principles to carry out the tasks carefully. It should be taken care of very strictly that no one is harmed physically or emotionally while conducting the research (By & Rune., 2005).

3.8 Limitations of the study

The current study has been conducted under the following limitations.

- Time constraints because the researcher has job commitments. Therefore, the study was limited to limited number of institutions.
- Focused at one place (South Batinah Governorate) and cannot be expanded to other places in Oman. Therefore, the generalization of the results of the study might be questioned.
- The sample size may have considered not large enough. Although it is not that much large, but satisfactory for analysis in order to satisfy statistical threshold requirements.

3.9 Delimitation

The current research is focused on a common phenomenon that is widely presented in the previous literature. Anyhow, to the extent of information on published data there were no studies found under the topic in the context of Oman. Therefore, setting the research objectives, questions and theoretical framework was a neutral activity. The topic has a broader scope but the current research is considered to be at an exploratory level and limited to major four factors independent variables. The selection of respondents is free from biased and purposiveness. First and basic research may lead to further clues of research in the same direction (Lee, 2010). The study has been conceptualized as of basic nature to guide to the further research in this topic.

3.10 Ethical considerations

Any inquire about examination including human subjects, there must use caution thought of ethical issues which will emerge within the arranging, conduct,



And announcing of the ethical considerations in research are critical in conducting research. The current research has maintained the norms or standards for conduct that distinguish between right and wrong as following

- Data collection includes the informed consent from the Ministry of Education.
- The voluntary participation of participants was ensured without any influence on their independent opinion.
- Data presented in the current research was reported without any fabrication and alteration.
- The information of respondents and the original data were kept confidential and the same was communicated to the respondents in the questionnaire.
- Confidentiality of the data was assured to the participants
- The current research has ensured the anonymity



4. Findings and Analysis

4.1 Introduction

This chapter presenting results of the study that aims at finding the impact of resistance to change on the implementation of Quality Management System in the Ministry of Education in Oman. As stated in the first chapter of this research, the study tried to answer the following four questions:

RQ1: What is the level of resistance to Implementation of Quality Management System (QMS) in the (MOE) of South Batinah based on staff and directors' perceptions?

RQ2: What are the factors that account higher to resistance to change?

RQ3: Is there any significant difference in opinion regarding resistance to Implementation of Quality Management System (QMS) in the (MOE) according to years of experience?

RQ4: Is there any significant difference in the opinion regarding resistance to Implementation

of Quality Management System (QMS) in the (MOE) according to the educational level? Besides, this research has specific four objective derived from the research questions, as previously mentioned in the first chapter as follows:

- 1. To assess the level of resistance to Implementation of Quality Management System (QMS) in the (*MOE*) by directors and staff perceptions.
- 2. To find out the factors of resistance that account higher to resistance and make recommendations to overcome the issue of resistance
- 3. To investigate the significant difference in the opinion regarding resistance to the implementation of Quality Management System (QMS)based on years of experiences.
- 4. To investigate the significant difference in opinion regarding resistance to Implementation of Quality Management System (QMS) according to years of educational level.

4.2 Demographic characteristics

The study sample consisted of (59) employees who works in the Ministry of Education in South Batinah governorate in Oman, only (54) of them correspond to the questionnaire due to the vacancies in some heads of departments. However, the total individuals (54 out of the total 59) was sufficient and expressive for calculating the data analysis.



| Education level | Fynerience | | Total | | | |
|------------------|-----------------|----|-------|---|--------|----|
| | Experience | Ma | Male | | Female | |
| Bachelor or less | Less than 3 Yrs | 4 | 66.6% | 2 | 33.3% | 6 |
| | 4-5Yrs | 8 | 100% | 0 | 0% | 8 |
| | More than 6 Yrs | 9 | 90% | 1 | 10% | 10 |
| | Total | 21 | 87.5% | 3 | 12.5% | 24 |
| Postgraduate | Less than 3 Yrs | 7 | 100% | 0 | 0% | 7 |
| | 4-5Yrs | 7 | 77.7% | 2 | 22.2% | 9 |
| | More than 6 Yrs | 14 | 100% | 0 | 0% | 14 |
| | Total | 28 | 93.3% | 2 | 6.6% | 30 |
| Total | Less than 3 Yrs | 11 | 84.6% | 2 | 15.3% | 13 |
| | 4-5Yrs | 15 | 88.2% | 2 | 11.7% | 17 |
| | More than 6 Yrs | 23 | 95.8% | 1 | 4.1% | 24 |
| | Total | 49 | 90.7% | 5 | 9.2% | 54 |

Table 1: Description of the participants according to gender, experience and education level.

Above -Table 1- shows that 90.7% participants were male and 9.25% female. This indicates that majority of the participants were male.

4.3 Research questions analysis:

RQ1: What is the <u>level</u> of resistance to Implementation of Quality Management System (QMS) in the (MOE) based on staff and directors' perceptions?

To answer this question, Mean and standard deviation were calculated for the scores of the study sample. The Mean was compared with the Assumed Mean of the scale whose value (3). One-sample t-Test used to indicate whether statistical significant difference existed between Mean and Theoretical Mean. Table (2) shows One-sample t-Test result.

Table 2: One-sample t-Test result.

| Variable | *Assumed Mean | Mean | t | df | Sig. (2-tailed) |
|---------------------|---------------|------|------|----|-----------------|
| level of resistance | 3 | 3.15 | 3.23 | 53 | 0.002 |

* Assumed Mean= (Higher degree (5) +Lower degree (1) /2)



The results in table 2 showed that there was significant difference at the p<.05 level between the mean that calculated from sample individuals responses (M=3.15) and the Assumed Mean (3), t(53)=3.23,P=0.002, therefore it can be concluded that the level of resistance to Implementation of (QMS) in the (MOE) based on staff and directors' perceptions is high.

The high level of resistance to change based on staff and directors' perceptions is due to several reasons

- The way of the QMS managing, precisely the process of documentation that takes time and effort within a very long and complex procedure. therefore, most of the respondents believe that QMS must be electronically systemized with all its documents to ease the continual upgrading of the forms.
- The ineffective role of the top management toward the QMS implementations.
- The misunderstood and ambiguity about how to deal with the QMS requirements
- The lack of training programs has impacted on the level of employees' perception (Quality Specialists)
- Lack of employees' competence in some departments.

Most of these reasons correspond with the researchers (Carlon et al., 2012: Jones, 2013; Goetsch, & Davis, 2014) in literature review in this study.

RQ2: What are the factors that account higher to resistance to change?

To investigate the factors that lead to resistance to change this study takes Al-Haddad & Kotnour(2015) and Witting (2012) of a four-factors model as follows:

- 1. Routine Seeking
- 2. Emotional Reaction
- 3. Short-term thinking
- 4. Cognitive rigidity

To come up with answering this question mean and standard deviation were calculated to determine factors that account higher to resistance to change. Table 2 shows the results.



Table 3: Mean of factors that lead to resistance to change in the light of implementing QMS (items 6-25).

| Factors | N | Mean (M) | Standard Deviation (SD) |
|---------------------|----|----------|-------------------------|
| Cognitive Rigidity | 54 | 3.56 | 0.61 |
| Emotional Reaction | 54 | 3.24 | 0.50 |
| Short-Term Thinking | 54 | 3.23 | 0.49 |
| Routine Seeking | 54 | 2.29 | 0.39 |

Table (3) shows the mean of the factors that lead to resistance to change in the light of implementing QMS. The mean value ranged between (2.29-3.56), the highest of which was the Cognitive Rigidity (M=3.56, SD=0.61), while the lowest factor was Routine Seeking (M=2.29, SD=0.39). Figure 1 shows the difference between the factors mean, this indicates that Cognitive Rigidity account higher to resistance to change.



Figure 1: Mean of factors that lead to resistance to change in the light of implementing QMS

Figure 1 shows that the most of the four factors are closely impact the level of the resistance to change according to staff and directors' perceptions, cognitive rigidity factor is the highest because of the lack of intensive and systematic training, participation and involvement. The factor recorded the lowest level of resistance to change is routine seeking, therefore, This indicates that the employees have the readiness for change but they need support by setting some plans regarding the training programs and a very just welfare system to create a feeling of satisfaction to deal with the QMS.



RQ3: Is there any significant difference in opinions regarding resistance to Implementation of Quality Management System (QMS) in the (MOE) according to <u>vears</u> <u>of experience</u>?

One-way ANOVA was conducted to compare the effect of years of experience on Implementation of Quality Management System. There was no significant effect of years of experience on Implementation of Quality Management System at the p<.05 level [F= 0.98, p = 0.382]. Table 3 shows One-way ANOVA results according to years of experience.

| Table 4: One-way ANOVA of resistance to implementation of (QMS) according experience | Table 4: One-way | ANOVA of | f resistance to | Implementation | of (QMS) | according ex | xperience |
|--|------------------|----------|-----------------|----------------|----------|--------------|-----------|
|--|------------------|----------|-----------------|----------------|----------|--------------|-----------|

| Source of variance | Sum of Squares | df | Mean Square | F | Sig. |
|--------------------|----------------|----|-------------|-----|------|
| Between Groups | 0.23 | 2 | .117 | | |
| Within Groups | 6.07 | 51 | .119 | .98 | .382 |
| Total | 6.31 | 53 | | | |

Specifically, the results show that Implementation of Quality Management System (QMS) in the (MOE) does not change as the years of experience changed. Figure 2 illustrates the means of resistance in terms of the years of experience.



Figure 2: Mean of resistance to Implementation of (QMS) according experience



RQ4: Is there any significant difference in opinions regarding resistance to Implementation of Quality Management System (QMS) in the (MOE) according to <u>Educational level</u>?

An independent sample t-test was conducted to determine whether there was a difference in opinions regarding resistance to (QMS) in the (MOE) according to Educational level. Table (4) shows the independent sample t-test.

Table 5: An independent sample t-test of difference in opinion regarding resistance to

 Implementation of (QMS)

| Educational level | Ν | Mean | Std. Deviation | t | df | Sig(2-tailed) |
|-------------------|----|------|----------------|------|----|---------------|
| Bachelor or less | 24 | 3.14 | .36 | .192 | 52 | .849 |
| Postgraduate | 30 | 3.16 | .34 | | 02 | |

As noticed in Table 4, there was no significant difference in perception regarding resistance to Implementation of (QMS) between participants who have Bachelor or less (M=3.14, SD=.36) and Postgraduate participants (M=3.16, SD=.34); t (52) = .192, p =.849.



Figure 3: Mean of resistance to Implementation of (QMS) according to educational level It can be seen from Figure 3 that there are no differences in the resistance to implementation of (QMS) according to educational level.



5. Conclusion and Suggestions

5.1. Conclusion

To conclude, issues of change in the organizations must have several considerations. Managing the change needs to consider several issues like the organizational structure, behavior, context, transparency and participation. The researcher tried to answer the four main questions stated in first chapter and to find out the main behavioral challenges behind the resistance to change while dealing with the QMS implementations in the Ministry of Education in Oman, also it studied the correlations between the impact of years of experience, level of education to the level of resistance to change. The instrument was used to investigate the problem is the questionnaire, the respondents were chosen from the heads and directors in the general Directorate of Education in south Batinah governance as a model of the study.

Statistical analysis pointed out that the level of resistance to change is high and cognitive rigidity factor has recorded the most behavioral impact, also the research questions 3 and 4 indicated with no significant differences of the years of experience and educational level of the respondents, however, the two factors statistically recorded a very closely results.

Accordingly, the Ministry of Education must follow a systematic plan to avoid the high level of resistance through setting intensive training programs beside a good welfare system to create an appropriate climate to make the employees encouraged to deal with new developments, also must prepare the top management leaders to take practical supportive actions to smooth the change procedures and to create general acceptance between the employees.

5.2 Recommendations to overcome the resistance to change:

- 1. There is a strong need of top management support toward the QMS implementations in the Ministry of Education.
- 2. The Ministry of Education must have a clear and systematic training plan for all employees in the different administrative levels to make a clear vision on how to deal with the QMS requirements.
- 3. The QMS must cope with the technical requirements to unify the documentation process and control the distractive procedures.
- 4. Set a plan to investigate the reality of the work in the different departments and find the challenges to make the QMS smoothly implemented.



- 5. There must be a very skillful and competent reference to deal with the nature of the QMS requirements.
- 6. Overcoming the gap between the theoretical and practical part of the QMS.
- 7. Flexibility is required within the scope of the regulations and official design.
- 8. Decentralizing the QMS implementation is must to have more productivity.
- 9. There must be a bridging between the theoretical part and the practical part of the QMS implementation.
- 10. The MOE need to have a clear vision on how to change the organizational culture to pave the way towards the employees' performance and production.

6. References

- Al-Tarawneh, H., &Mubaslat, M. (2011). The implementation of total quality management (TQM) on the higher educational sector in Jordan. International Journal of Industrial Marketing, 1(1), 1-10.
- Ali, M. M., Abdulhamed, K. R., & Humaidalwaili, (2015). Actuality of Applying Total Quality Management in Omani Schools. International Journal of Scientific & Technology Research (4)11.
- Al-Haddad, S., & Kotnour, T. (2015). Integrating the organizational change literature: a model for successful change. Organizational change management.
- Alibabić, Š. (2010). Change management–andragogical professional challenge. Adult Education: The Response to Global Crisis Strengths and Chalenges of the Profession, str, 109-127.
- Alkawaz, M. H., Sulong, G., Saba, T., &Rehman, A. (2018). Detection of copy-move image forgery based on discrete cosine transform. Neural Computing and Applications, 30(1), 183-192.
- Anderson, D., & Anderson, L. A. (2010). Beyond change management: How to achieve breakthrough results through conscious change leadership (Vol. 36). John Wiley & Sons.



- Andrade, J. L. (2017). Perceived psychological empowerment and total quality management-based quality management systems: exploratory research. Total Quality Management & Business Excellence 28.1-2, 76-87.
- Boohene, R., & Williams, A. A. (2012). Resistance to organisational change: A case study of Oti Yeboah Complex Limited. International Business and Management, 4(1), 135-145.
- Brookes, M., & Becket, N. (2007). Quality Management in higher education: a review of international issues and practice. International Journal of Quality Standards, 1(1), 85 -121.
- Burke, W. W., Lake, D. G., & Paine, J. W. (Eds.). (2008). Organization change: A comprehensive reader (Vol. 155). John Wiley & Sons.
- Bush, T., Middlewood, D., Morrison, M., & Scott, D. (2005). How Teams make a Difference? The Impact of Team Working.
- Cameron, E., & Green, M. (2019). Making sense of change management: A complete guide to the models, tools and techniques of organizational change. Kogan Page Publishers.
- Canning, J., & Found, P. (2015). Resistance in Organisational Change. International Journal of Quality and Service Sciences, 7(2/3), 274-295.
- Carlon, D., Downs, A., Pieterse, J. H., Caniëls, M. C., & Homan, T. (2012). Professional discourses and resistance to change. Journal of Organizational Change Management.
- Dessler, G., Starke, F. A., & Cyr, D. J. (2001). Management: Leading people and organizations in the 21st century. Upper Saddle River, NJ: Prentice Hall.
- Devos, G., Buelens, M., &Bouckenooghe, D. (2007). Contribution of content, context, and process to understanding openness to organizational change: Two experimental simulation studies. The Journal of social psychology, 147(6), 607-630.



- Finkelstein, L.M., Burke, M.J. and Raju, N.S. (1995), "Age discrimination in simulated employment contexts: an integrative analysis", Journal of Applied Psychology, Vol. 80 No. 6, pp. 652 663.
- Forrester, D., McCambridge, J., Waissbein, C., Emlyn-Jones, R., & Rollnick, S. (2007). Child risk and parental resistance: can motivational interviewing improve the practice of child and family social workers in working with parental alcohol misuse?. British Journal of Social Work, 38(7), 1302-1319.
- Fullan, M. (2001). The new meaning of educational change. Routledge.
- Goetsch, D. L., & Davis, S. B. (2014). Quality management for organizational excellence. Upper Saddle River, NJ: pearson.
- Hornstein, H. A. (2015). The integration of project management and organizational change management is now a necessity. International Journal of Project Management, 33(2), 291-298.
- Issan S, Gomaa N (2010). Post Basic Education Reforms in Oman: A Case Study. Lit. Inf. Comput. Educ. J. 1(1). Learning Point Associates (2004). Guide to Using Data in School Improvement Efforts: A Compilation of Knowledge From Data Retreats and Data Use at Learning Point Associates. www.learningpt.org. retrieved on December10, 2019.
- Jones, G. R. (2013). Organizational theory, design, and change. Upper Saddle River, NJ: Pearson.
- Kane, H., Ragsdell, G., & Oppenheim, C. (2006). Knowledge management methodologies. The Electronic Journal of Knowledge Management, 4(2), 141-152.
- Kavanagh, M. H., &Ashkanasy, N. M. (2006). The impact of leadership and change management strategy on organizational culture and individual acceptance of change during a merger. British journal of management, 17(S1), S81-S103.
- Kotter, J. P., & Schlesinger, L. A. (1989). Choosing strategies for change. In Readings in strategic management (pp. 294-306). Palgrave, London.



- Leavitt, H. J., & Bass, B. M. (1964). Organizational psychology. Annual review of psychology, 15(1), 371-398.
- Lewis, L. (2019). Organizational change. John Wiley & Sons, Incorporated.
- Lines, B. C., Sullivan, K. T., Smithwick, J. B., & Mischung, J. (2015). Overcoming resistance to change in engineering and construction: Change management factors for owner organizations. International Journal of Project Management, 33(5), 1170-1179.
- McFadden, M. A., Patterson, W. P., Mullins, H. T., & Anderson, W. T. (2005). Multiproxy approach to long-and short-term Holocene climate-change: evidence from eastern Lake Ontario. Journal of Paleolimnology, 33(3), 371-391.
- Ministry of Education (2014). National Report on Quality Education in Oman. Ministry of Education, Muscat, Sultanate of Oman
- Nasser, R. (2019). Educational Reform in Oman: System and Structural Changes. In Education Systems around the World. IntechOpen.
- Neck, C. P. (1996). Thought self-leadership: A self-regulatory approach towards overcoming resistance to organizational change. The International Journal of Organizational Analysis, 4(2), 202-216.
- Oreg, S. (2003). Resistance to change: Developing an individual differences measure. Journal of Applied Psychology, 88(4), 680-693.
- Peiffer, S. E. (2016). "The Impact of Human Factors on a Hospital-Based Quality Management System. The Journal for Quality and Participation 39.3, 19
- Pheng, L. S. (1997). Quality management systems: a study of authority and empowerment. Building Research & Information 25.3, 158-169.
- Plutchik, R. 1983. Universal problems of adaptation: Hierarchy, territoriality, identity, and temporality. In: Environment and population: Problems of adaptation, ed. Calhoun, J.B. New York: Praeger.



- Pratasavitskaya, H., & Stensaker, B. R. (2010). Quality management in higher education: Towards a better understanding of an emerging field. Quality in Higher Education, 16(1), 37-50.
- Pratasavitskaya, H., & Stensaker, B. R. (2010). Quality management in higher education: Towards a better understanding of an emerging field. Quality in Higher Education, 16(1), 37-50.
- Rosa, M. J., Sarrico, C. S., & Amaral, A. (2012). Implementing quality management systems in higher education institutions. Quality assurance and management, 129-146.
- Sallis, E. (2014). Total quality management in education. Routledge.
- Saunders, M., Lewis, P. & Thornhill, A. (2012) "Research Methods for Business Students" 6th edition, Pearson Education Limited.
- Shimoni, B. (2017). What is resistance to change? A habitus-oriented approach.
 Academy of Management Perspectives, 31(4), 257-270.
- Todnem By, R. (2005). Organisational change management: A critical review. Journal of change management, 5(4), 369-380.
- UNESCO (1998, October). Declaracao Mundial Sorbe Educacao. Retrieved December, 2019, from http://unesdoc.unesco.org/images/0014/001419/141952e.pdf.
- Van Dam, K., Oreg, S., & Schyns, B. (2008). Daily work contexts and resistance to organisational change: The role of leader–member exchange, development climate, and change process characteristics. Applied psychology, 57(2), 313-334.
- Weiner, S., & Wagner, H. D. (1998). The material bone: structure-mechanical function relations. Annual review of materials science, 28(1), 271-298.
- Wittig, C. (2012). Employees' reactions to organizational change. Od practitioner, 44(2), 23-28.
- Yılmaz, D., & Kılıçoğlu, G. (2013). Resistance to change and ways of reducing resistance in educational organizations. European journal of research on education, 1(1), 14-21.



 Yılmaz, D., & Kılıçoğlu, G. (2013). Resistance to change and ways of reducing resistance in educational organizations. European journal of research on education, 1(1), 14-21.

Copyright © 2022 Mr. Hamed Salim Said AL Basami, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC) Doi: <u>https://doi.org/10.52132/Ajrsp.e.2022.33.2</u>



Cyber Attacks Visualization and Prediction in Complex Multi-Stage Network

Mr. Jassir Adel Altheyabi

Master's in Cyber Security, Cyber Security Department, Majmaah University, Kingdom of Saudi Arabia

Email: Eng.Jasir@Gmail.com

Abstract:

In network security, various protocols exist, but these cannot be said to be secure. Moreover, is not easy to train the end-users, and this process is time-consuming as well. It can be said this way, that it takes much time for an individual to become a good cybersecurity professional. Many hackers and illegal agents try to take advantage of the vulnerabilities through various incremental penetrations that can compromise the critical systems. The conventional tools available for this purpose are not enough to handle things as desired. Risks are always present, and with dynamically evolving networks, they are very likely to lead to serious incidents. This research work has proposed a model to visualize and predict cyber-attacks in complex, multilayered networks. The calculation will correspond to the cyber software vulnerabilities in the networks within the specific domain. All the available network security conditions and the possible places where an attacker can exploit the system are summarized. The vulnerability-based multi-graph technique for the attacker is presented using a matrix. Also, an attack graph algorithm is proposed, leading to the identification of all the vulnerable paths that can be used to harden the network by placing sensors at the desired locations. The presented attack graph is used for vulnerability assessment of Multi-Stage Cyber Attacks.

Keywords: Network vulnerability; attack graph; adjacency matrix; clustering technique; cyber defense.



1. Introduction

In recent years, there is effective use of the Internet and related technologies. Identifying different types of models that are responsible for providing services based on the internet and network can be said to be increasing day by day. With the use of the internet, the amount of data collected on servers and network computers is increasing significantly. The availability of vulnerable and critical data on the systems makes it very easy for the attacker, and the breach of data impacts companies' intellectual property (Mishra et al., 2021). The threat of information leakage or attack on network-based devices is increasing day by day. It is high time to figure out how these attacks can be mitigated or rather prevented and thus programmers all over the world are trying to develop and design systems that are capable of detecting the intrusion of non-ethical attackers from remote locations (Gupta et al., 2020). A large number of cybercrimes are being reported every now and then and based on these, vulnerabilities are identified (Mishra et al., 2020), (Mishra et al., 2021). Intrusion detection can be done in two ways: an intrusion detection system and an intrusion prevention system. However, the prevention system only assigns the risk of getting an exploit while on the other hand, the detection system can raise the alarm and detect a threat to the softwarebased system or server machines. The availability of such systems is indeed the need of the hour, and more secure mechanisms are required to be designed as well as developed to protect the privacy and integrity of data of individuals (Sarker et al., 2020), (Mishra, 2020). As a general approach, the intrusion detection system is more efficient and categorized based on specific parameters that are:

Analyzed Activities: The system that can analyze the activities taking place in the network and at the same time also detects the involvement is taken under the purview of activity-based intrusion detection system.

Host Intrusion Detection System: The system that can get attached to the host machine and thereafter formulate an identifier is taken under the purview of host intrusion detection systems.

Both the above methods use either signature-based activity or host detection, or anomaly-based detection. Depending on host's signature trying to communicate on the network, intrusion can be detected, or anomaly-based detection can be used to detect intrusion.

However, in both cases, it is impossible to identify a specific type of intrusion or predict how the network path may manage itself at the time of intrusion (Aldweesh et al., 2020).



In this paper intrusion, detection systems that are effective to identify attacks or exploits in the network have been discussed upon.

The main objective of this research is to identify an approach that can calculate all attack locations in any computer network.

There are various ways in which the attack location can be identified by making use of a graph, and other such similar approaches can be taken. The optimal placement of the graph in the network is helpful enough to identify and provide the positions where the attack is most likely to happen.

In this research, the proposed model performs both visualization as well as prediction of the attacks. The computation corresponds to the cyber software vulnerabilities in the networks within the specific domain. The attacker will try to exploit the ocean of the network that is vulnerable to attacks. The central ideology behind this particular approach is to identify the gray areas responsible for any exploitation of the network by the attacker. For this purpose, traditional graph-centric modeling and adjacency matrix have been used. Also, given all known attack areas of the network, an attacker will always try to identify and evaluate all locations in the network path that provide opportunities for exploitation. This approach continues with an enhanced version of network hardening, that identifies areas where exploitations. This makes correlation and prediction very simple that in turn helps secure the network in a better way. The attack graphs can be created and examined for further placement of vulnerability assessment tools. The visualization of the attack graphs can be done using various visualization techniques that are available these days.

The paper is structured in the following way:

The literature of attack graph, a type of vulnerability-based multi-graph technique for the attacker, is discussed in section 2. Proposed model, vulnerability assessment, adjacency matrix, clustering algorithm in homogeneous groups, multi-Step attack path identification, and detected intruders are presented in section 3. Section 4 discusses the results and section 5 concludes the paper with some of the future directions.

2. Literature Review

In recent years, there have been several advancements in attack graphs as a result of which it is now possible to create an attack graph or realistic computer networks. For a long time, researchers have been trying to process the information relevant to attack graphs and their creation,



along with real-time network systems (Husak et al., 2018). We have studied many such techniques for the composition of our approach to make it very effective (Liu et al., 2020).

The methods presented in this research mainly focused on creating the adjacency matrix from the attack graphs (Ghadi et al., 2020). A similar author also gave a robust report on vulnerability assessment using attack graphs. In (Liu et al., 2020), the authors presented a very strong approach to network security and proactive prevention of intrusion at various stages. According to the details prescribed in (Lallie et al., 2020), the vulnerability was one of the most important reasons for cyber-attack. The identification of such vulnerabilities was most important and presented in the study indicated by (Pirani et al., 2021). Another critical part of our project is the visualization technique for the attack graphs. The prescribed theory proposed by (Cinque et al., 2020) formed the basis for graph visualization. In (Stergiopoulos et al., 2021), the authors presented another fantastic technique for visualization, which was integrated into one of the research methodology modules in this study. The most crucial part of our research is the placement of appropriate sensorbased devices at vulnerable positions. Identification of such vulnerable positions is another important part required for the study. A schematic representation is possible for placing sensors at a suitable position for alerting and prioritizing in the attack graphs.

The author proposed a robust design for placing sensors in the attack graphs for appropriate responses in cyberspace (Pourhabibi et al., 2020). The next phase of the research deals with identifying attack points and hardening the network to avoid vulnerability. The attack graph hardening techniques prescribed in the study (Ibrahim et al., 2020), (Sansavini & Parigi, 2020) that makes use of topological analysis gives a new dimension for managing cyber threats at the time of vulnerabilities. Thus, topological analysis for vulnerabilities became the backbone of the study and proposal. A structured method for finding the correlations between the intrusion events and the attack scenario is with the help of attack graphs. However, these graphs are considered to be very complex, and the hierarchical aggregation of these graphs was presented in (Singhal & Ou, 2017).

The methodology proposed in the research (Stergiopoulos et al., 2021), (Yang et al., 2019), (Ramadan, 2020), has proven to be a positive solution to various network-based vulnerability and exploitation problems. The ideology derived from this research, focused on identifying vulnerabilities and providing a smooth mechanism to eliminate these problems at various stages.



The proper results for the proposed research can only be achieved with the help of the entire architecture. As described in the studies of (Pirani et al., 2021), the comprehensibility of the complex graph for the networks can be done with the help of the algorithm proposed by the researcher.

Each edge of the graph represents a network path in the proposed study and the interconnectivity of the different edges in the network graph is represented in the form of an adjacency matrix, which becomes the second important pillar of the study of (Lallie et al., 2020), (Pirani et al., 2021), (Russo et al., 2019). However, the analysis of the complex graph alone is not enough to identify the gray areas. Thus, to find a suitable solution for the same, it was vital for us to find an appropriate means to visualize the data (Ivanov et al., 2020).

In (Medvedev et al., 2021), the authors proposed a very effective ideology for visualizing the data from the graph in a systematic manner which will be helpful enough to identify the network vulnerabilities.

With the help of this particular information, it will be very easy for the algorithm as well as the methodology to identify the problems and predict the type of network problems that might arise (Nia et al., 2019). The approach that has been proposed in the method tries to give a probable solution to the problem that may occur due to vulnerabilities in a particular network when there are opportunities for exploits. In the last two decades, the issue of cybersecurity has become most significant. A large number of researchers have come up with various protocols and techniques to identify and deal with these problems (Das et al., 2021).

Many studies have been considered, and thereafter a new methodology for network security applications based on complex attack graphs has been derived (Lallie et al., 2020). A large number of operations were studied to find out the regularities in the graphs, which could be a probable cause for graph clustering that can lead to changes in network configuration. Various research done by scholars from different parts of the world have been studied to visualize data from the graphs (Ghazo et al., 2019). The appropriate visualization of the attack graphs and their adjacency matrix formed the foundation of this research, as well as the provision of an appropriate suitable format in which this can be studied very easily.



Identifying all exploitation parts from the graph using various prediction techniques coupled with the underlying principle of vulnerability and evaluation makes this approach a game-changer in the realms of network security.

The approach used in this particular research develops a technique for identifying complex attack graphs. It is undeniable that in large networks a large number of densely connected subgraphs occur. However, most of the vulnerabilities in the network tend to occur in this particular subgraph. The adjacency matrix for the corresponding attack graphs represents the edges that are most vulnerable to network attacks.

An information-theoretic clustering technique is applied to identify the branches of the adjacency matrix in the graph. However, the clustering technique is assumed to be fully automatic, which requires linear scaling. In general, the elements of the adjacency matrix represent the steps during an attack. With the help of these edges, the reachability of the attacker can be identified. After identifying the various factors, a single matrix can be derived. The method presented in the research tries to deal with all the possible steps and the part that is a transitive closure of the attacker's graph. The method used in this particular research considers the vulnerability-based graph attack. All the available network security conditions and the possible places where an attacker can exploit the system are summarized, with the help of this representation.

With this the attacker's attack patterns can be made clear. The attacker represents the vulnerabilitybased multi-graph technique with the help of a matrix. However, the approach is straightforward, yet there are chances for anomaly or complexity to arise as a general scheme.

As a general scheme. It can be seen that the following assumptions are possible when applying the vulnerability assessment approach in attack graphs.

- The network is assumed to be finite.
- The vulnerability assessment is performed using the attack graph.
- It is assumed that the analysis of the graph NP is complete.
- The approach can be used to identify an optimal solution for network hardening.
- It is not mandatory that all the paths of the network are identified.
- The prediction is not intended to be complete and there may be other solutions for a particular network path.
- Penetration testing or exploitation is not an integral part of this methodology.



- The analysis and synthesis of the attack graph are done based on the parameters provided by the network.
- The vulnerability assessment is intended to provide the grey areas where a solution is required. However, it can be further refined and simplified to provide more accurate results. The accuracy of the approach varies from network to network and can be further simplified by improving graph analysis algorithms.

3. Research Methods

The research is divided into the main elements for creating the attack graphs, identifying the matrix, placing intrusion detection devices in appropriate locations, and finally making the network security metrics for the cyber-attacks.

1. This leads to the creation of the attack graphs using the vulnerability assessment in the topologies.

2. This leads to our noble approach responsible for applying adjacency matrix criteria for cyber-attack graph analysis.

3. Gives the placement positions for various network intrusion detection devices in the particular network for which the cyber-attack graphs are generated.

4. Provides us the final and effective method as per the research for identifying the exploitation, locations, and placement of network intrusion detection devices using the attack graphs.

Vulnerability assessment can be performed by creating cyber-attack graphs. An associative step in this particular milestone could be identifying network security using the attack graphs if possible, in the preliminary stage. The second milestone is the identification of the attack graph matrix. It can be created using different types of cyber-attack graph techniques listed in the background section. The matrix clustering algorithm will be helpful enough to find out different edges to identify the adjacency matrix. Finally, the transformation of the adjacency matrix can be done to represent different multi-stage attacks that are possible for the exploit domains. Prediction is based on attack and impact using a reachability matrix from attack graphs. According to the adjacency matrix and attack graphs, the placement of attack-based sensors responsible for identifying and tracking any type of attack in the network is the third important step in this particular research. The identification of optimal sensor placement can be done using various optimization algorithms.



In this approach, a new and effective method for identifying placement positions using attack graphs has been proposed. The last important milestone for this research will be the identification of security metrics derived using attack graphs. This matrix will identify and provide the full security value based on the attack graphs created in the first and second steps, by using the above approach, the attack graph module will be built.

3.1 Vulnerability Assessment

The main backbone of this ideology revolves around vulnerability assessment. The assessment we make regarding vulnerabilities depends on the topography in which all the network elements are arranged. The analysis of all the vulnerabilities and interdependencies is done with the help of a graph. Some researchers have used this kind of approach to identify the vulnerabilities based on the topology.

The important part states that all the connected elements to the network are checked for vulnerabilities in network configuration, software configuration, connectivity, parameters, and hardware configurations. Cross-mapping is performed using network-based vulnerability sections where an intrusion is likely to occur. The custom scenarios are targeted and checked for vulnerabilities. The attack graph created using all, the topological assessments of the vulnerability mainly, focuses on the ways of penetration in a network. This provides a very proactive approach where all the sections that are likely to be prone to vulnerabilities are considered. It makes intrusion detection more effective at these points, and it is possible to respond very well to the attacks.



Figure 1: Overview of the Situation

A generic overview and configuration of the network and the exploitation by the hacker is shown in Fig. 1.





Hacker wants to take advantage of the fact that the vulnerabilities can be exploited once the configurations of the network are available and penetration is possible. The attack graph created from the situation is used for decision-making, which will help to find out the optimal priorities for all the hardening factors responsible for the vulnerabilities in the network. The attack graph is used to model the vulnerabilities of the systems and their potential exploits. Various strategies can be identified and optimized using the attack graph, based on the scenarios shown in the figure above. The remaining part of the graph will provide all the information needed to identify an intrusion at a particular point and all the flexible issues vulnerable to that intrusion. The attack model used by the hacker is mapped with the simulation available in the model and provides scenarios such as attack visualization, vulnerability mitigation, or security metrics based on the model used. In turn, intrusion detection can be performed, and an appropriate attack response mechanism can be designed to respond to the intruder's attack model.

The attack graph that is created can also help identify a multi-stage attack parameter for the network intrusion. Fig. 2. shows a sample network for generating the attack graph.



Figure 2: Sample Network for the Generating the Attack Graph

A small network is assumed to be available as a demonstration for the attack graph generation system. It is assumed that the main server and the file server are used for internal purposes, and the webserver allows connections coming from outside the network. The firewall blocks all traffic coming from outside the network and allows only those that are potentially secure connections. Considering the scenario, it can be seen whether an attacker could come from outside and compromise the mail server. To simulate this particular scenario with the creation of the attack graph, there is a need to identify the configuration elements on the network for the intrusion. There may be vulnerable software on the systems on the host computer that can act as a vulnerable device. The most important part is that it depends on the security tool that is available on the network and used for scanning vulnerabilities or attacks.



This can be considered as the most important meaning and limitation of the model that is proposed. With the help of this technique, the hacker can access the victim's machine in the network irrespective of any particular method or exploit mechanism.

Scanning of the system is done with the help of a firewall to capture present vulnerabilities, when an attacker tries to enter the internal network. As an alternative technique, the firewall rules can be processed to build the network model to ensure a high level of security. The first and most important step that the attacker will perform in a particular network is to find out the devices that are vulnerable and have some area in the configuration that can be exploited. Once the attacker has penetrated the network, he can execute malicious code and exploit the network's vulnerabilities. Even the firewall can sometimes identify such critical points and then place the compromise text for the information. It can also be noted that even if a single vulnerability is identified in the network, it can save and protect other attacks in the present scenario. Generally, when there are various methods and packages possibly for penetrating the network, this model is limited to identifying a particular critical path that can be a threat source to the entire network,

excluding all other machines. In the above figure, the file server is not an integral part of the exploit, hence it is removed. As it is not an integral part of vulnerability analysis using topology. The attack graph for a compromised mail server is shown in Fig. 3. There is no direct path from the attacker to the file server in our network scenario that would connect any kind of vulnerability in the graph.



Figure 3: Attack Graph for a Compromised Mail Server in the demonstrative Network

The above figure represents the first stage of the attack graph, which can compromise the state of the mail server. Exposing the vulnerabilities possible in the firewall leads to a high level of exploitation by the firewall outside the network. In general, this exposure graph can be considered to provide information that a vulnerability originates from outside the network and attempts to access and exploit the system. Using this model, the attacker can execute any arbitrary type of suitable software in the network.



The above example shows a simple host available in the network which can be exploited using various techniques. The web server and the main server which is shown in the picture above can be a victim of exploitation multiple times. In a direct method, it is not possible to exploit a particular node. The compromise takes place. Perhaps with a sequence of steps followed by the attacker, or it can be done using multiple steps of exploits to determine the complete information by the attacker.

The vulnerability in the evaluation done using topology states many possible methods and paths to reach a particular node. Vulnerability assessment using topology is an approach where simulation is performed based on the network model. It depends heavily on identifying and collecting all the information for network configuration. The security of the network does not depend on single-time analysis. It is an interrelated process that takes place over a long period. The most important parts are protection, detection, final response, and providing the necessary inputs to the vulnerability. The most important is the discovery phase, where we try to identify which particular devices in instances are vulnerable.

However, a large number of devices cannot be detected, which is on the part of critical networkbased configurations. After identifying the compromised path, further planning can be done. However, to reduce the attacks, scan with prior knowledge of the vulnerabilities.

There are many statistical analysis techniques, but the concept of network hardening is said to be one of the most optimal techniques that can be used in conjunction with attack graph analysis. Network hardening can be done using the information available from a multi-level graph. All the threats that can be identified for each type of network intrusion can be mapped. For larger networks however, hardening the network at the first step of attack exploitation reduces network exploitation in the initial stage. Initial level hardening and the consequences are shown in Fig. 4.



Figure 4: Initial Level hardening and the consequences





The consequences of not hardening a particular first layer analysis may lead to internal exploits by the attacker. However, it can be further reduced when hardening at subsequent layers in the network.

Thus, hardening at the final layer may also be independent of the source of the attack. In general, the particular potential attacker can be exploited at any layer without prior notice. A good network vulnerability assessment technique will always try to protect this type of exploitation at any layer. Fig.4 depicts, the initial layer of connection to the network can be hardened from the outside world so that the chances of exploitation can be minimized using this particular technique. As in a general identification scheme for first-level defense, it becomes straightforward for identification and proactive defense to avoid any vulnerability occurring in the network at any point. However, the idea is not to exploit all inputs from outside the network, but only to prevent the attacker from finding out any possible level inside the network.

Security metrics consist of the vertices and edges of the graphs available from the network vulnerability assessment.

The size of the attack graph is only a basic parameter and an indicator quantifying the effort required against the attacks. To be more precise, attack graphs are not meant to provide security against and exploitation. Instead, they are recommended to secure the network against further exploitation and block the current problems associated with first layer security.

The normalization of the matrix was created using the information for the edges and patches within the attack graph can gave a good measure to reduce the uncertainties within the graph. So, with the help of creating the security matrix, we can protect the network from any kind of compromise situation. The remedial actions can be identified and ranked in terms of risk to maximize the security and minimize the cost.

3.2 General Scenario of the Model

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



Figure 5: General Scenario of the Model

Attack graphs can identify and provide the path of vulnerabilities and protect the optimal solutions required for a particular critical network vulnerable to attack. With the help of these attack graphs, optimal decisions are made to protect the network. However, for identifying the vulnerabilities and patching the required path in the attack graph, the remaining patches in the attack graph need to be identified. The information provided by this topology-based vulnerability assessment gives us an appropriate approach for the required proactivity to rescue the forces of the attacks that are possible on a compromised path. The general scenario of the model is shown in Fig. 5.

3.2.1 Creation of Adjacency Matrix

These attack graphs can be created using specified start and endpoints, depending on the Intrusion Alarm: relationship. The graph's vertices can consist of either the attacker exploit or the network security parameters and can be aggregated into a single matrix.

The proposed solution can handle all situations where either the attacker exploits or intrusion alarms are responsible for handling the situation. If we simply consider a network consisting of about 100 machines, the total number of applied vertices for a fully connected graph according to graph theory is 100 X 100. However, while drawing this attack graph, it will not be feasible to manage and handle all possible edges. So, in general, the total length of the matrix is 100 square matrixes.





In general, for a network with n machines, the adjacency matrix will have n X n values. For simplicity, if we assume that A is a matrix consisting of all edges from our text node i to j, then the element aij represents the matrix element connecting the two nodes. To minimize the resulting matrix, we can either represent the total edges present in the matrix with a value of 1 and all values with no connection or edge with 0. Another type of data structure called an adjacency list is responsible for this and is very useful. The only simple reason for this is that the list contains all edges and the vertices that have a connection, rather than managing a complete matrix with n X n elements.

3.2.2 Clustering Algorithm in Homogenous Groups

The machines represented by the vertices correspond to the same subnet or desired scheme that is in need. The nomenclature depends on the individual perspective for constructing the attack graphs and matrix. In general, it does not depend on the order of rows and columns, but it makes sense when we talk about clusters as a whole. Therefore, applying a clustering algorithm for this square matrix is required, similar to the one proposed by (C.Ma et al., 2021). The clustering algorithm can identify the presence of high and loose density clusters and the matrix. The locations where the clusters are highly dense provide information-theoretic optimality. According to the minimum description length principle of (Hu et al., 2020), data compression can be performed for the considered clusters. Alternatively, one can also represent this fact, since the compression of the data is well understood by the sense of the regularities captured.

In general, the idea revolves around the phenomenon of clustering in the matrix for a large number of elements that are part of the network. Once the minimum description length is identified, we can protect the cluster density and the intervention probability.

3.2.3 Multi-Step Attack Path Identification

In the previous section, we illustrated how the matrix creation could be done based on the different nodes present in the network. The attack graph is mapped to a matrix that is square in shape and order. This adjacency matrix that can be created represents all the edges of the connected network attack graphs. If we assume that matrix A is constructed with a square order, it will include all possible edges from one network port to another. For a square matrix with n elements, there are n x n possibilities that can be raised as Ap,
Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



Where we can assume that its value will be A A AA (P times). This can be represented mathematically in the form as equation number (1).

$$\mathbf{A}_{\mathbf{p}} = \mathbf{A}. \ \mathbf{A}. \ \mathbf{A}. \ \mathbf{A}. \dots \dots \mathbf{A}_{\mathbf{p}}$$
(1)

Let us now considered the matrix is raised to the power two, that can be represented as:

$$(A^2)_{i_j} = \sum_k a_{ik} \cdot a_{k_j} \tag{2}$$

As represented in the second equation, all the matching rows and the columns in the matrix multiplication will correspond to a particular matching step in the attack graph.

This type of submission can be done with the help of matching steps, and it leads to the discovery of the fact that each element of the matrix, obtained by the multiplication of the matrix A, will help us to identify the elements, responsible for a two-step attack between various bears as well as corresponding row and column of the attack graph matrix. The identification of A3 is going to lead us to the three-step attack elements. Thus, all the elements after the multiplication will comprise the intersection of a (i X j) value. As a rule, it can be reduced that for the multiplication of the adjacency matrix with the power n, the elements for the n- step attack graph can be identified. T multiplication for the same will provide arbitrary power that involves spectral decomposition for the matrix. Any Square matrix of the order n X n is supposed to have an eigenvalue that satisfies the eigenvalue equation: AV = VD

$$A = VDV^{(-1)}$$
(3)

In this equation, D represents the diagonal matrix. The eigenvectors V, corresponding to matrix A, can be calculated with the values of the elements available in the matrix. It is really simple and effective to prove that $Ap = VDpV^{-1}$

As a result, identifying the diagonal matrix for the pth power of matrix A will be very simple. The final representation for the diagonal matrix can be given as below:

$$D^{p} = \begin{bmatrix} d_{1}^{p} & 0 & \dots & 0 \\ 0 & d_{2}^{p} & \cdots & . \\ \vdots & & \ddots & 0 \\ 0 & \dots & \cdots & 0 \end{bmatrix}$$
(4)

The noble idea in this research represents that the multiplication of the matrix will be done to identify the Boolean product, irrespective of the numeric product value. According to a simple theory,



the final matrix identified after the product is taken will provide at least a peace step attack from one node in the matrix to another. The identified path based on the Boolean sum of the values identified can be given by:

$$A \lor A^2 \lor A^3 \lor \dots A^{n-1} \tag{5}$$

With the help of the classical Floyd Warshall algorithm, we can easily identify the close value of matrix A. However, more, better algorithms are proposed by (Liu et al., 2020), (Chen et al., 2020) for a similar task. As a simple approach. We can use that classical algorithm to find out the transitive closure of the matrix. It can be further well-identified that the number of elements will increase monotonically as the increasing value of p. This means that with the large number of steps we are trying to predict; larger elements will be included in the process. So, the minimum number of steps that can be required to reach particular attack graph vertices can be easily computed with the help of identifying the reachability matrix such as:

$$A + A^2 + A^3 + \dots + A^{n-1} \tag{6}$$

It should be well noted that the addition, here is the Boolean addition, and the multiplication is Boolean multiplication. All the steps that are considered in this research, make use of the Boolean arithmetic laws, irrespective of the classical mathematical rules. So, as a final golden rule, equation number 6, will give us the minimum possible steps that one attacker must attack.

3.2.4 Identification of the Detected Intrusions

In the previous two sections, we described the techniques used to create a possible version of the attack graph and determined the mathematical justification for the adjacency matrix. At this stage, we can identify the locations which are more vulnerable to attacks.

In this section, we will try to summarize all the possibilities and identify the optimal placement of sensors to detect intrusion using the attack graphs.

Network intrusion is possible at any point, but the critical assets must be secured in one of the two ways. To reduce the complexity of the analysis of identifying the situations and positions that are vulnerable to the work of the network model, we try to find out the points that are more vulnerable to the attacks.





And the placement of an appropriate sensor-based alarm system is done when an attack is identified at these points. However, it remains a myth that not all parts are burglar-proof. But the most critical parts that are present through the analysis of our research can be secured. For large computer networks. Vulnerabilities are very common. Based on the design and expansion Asiatic of the software that runs on the machines. After plugging the machine into the network, it becomes very risky and vulnerable to vulnerabilities. In terms, the traditional way of maintaining the network has been done with the help of placing sensors, but it is not at all the optimal solution to minimize the hardware cost of sensors and maintenance work as well. It can also be well realized that the ever-growing universe of greed and computing resources makes it very difficult to size the network.

With the advent of cloud computing technology, it has become even more challenging to identify the data and hardware boundaries, irrespective of global sharing. Thus, it becomes problematic and impossible to manage our wide area network with the help of sensor placements at all nodes. Indeed, the software responsible for device security is not complete. Even the most sophisticated software sometimes fails to detect vulnerabilities and attacks from a remote location. So, it becomes challenging to protect the entire network and all the machines located in that particular area. Many organizations are crazy about identifying malicious activities and attacks on critical data and data centers. Sometimes, network traffic and intrusion detection at higher rates with false alarm systems make it difficult for the organization to handle the hosted information.

However, with the help of vulnerability assessment, the impact of the attacks can be reduced to a larger extent. Previously, large number of traditional tools were used to identify the computer in the network and report the vulnerabilities of the computer. However, this becomes **a** laborintensive work and is very error-prone. While all the computers are connected and every computer is identified for vulnerability combinations. The key idea for this research revolves around the fact that they prefer to focus on the network's vulnerability rather than protecting the complete assets. We can ignore the assets of the network that are not part of the critical assessment.

The study attempts to develop a model of the entire network, including the topology and connectivity between different devices, to know the exploitation of the attacker.

The simulation for the attacks can be done using the model proposed in this study, and the prediction for the attack paths will be possible at the time of compromise for various assets, which are very critical at any point in time.



The core idea behind the study is to identify all the possible attack paths that are vulnerable and make them secure. Automating the old and traditionally available tools to secure the network is the core point behind the study. The hardening of the network can be done with the help of the analysis proposed in this paper. With its help, it becomes really easy to identify all the vulnerabilities and secure the entire network.

In a win-win situation, the use of attack graphs depending on the topology will be beneficial to reduce the impact of attacks. After all the attack paths are identified, it is very easy to place the sensors to detect or prevent intrusion attempts at the most critical vulnerabilities. It is also possible for the attacker to figure out another vulnerability path within the network for a likely attack. But using the prescribed model, all possible paths that are vulnerable can be protected from any type of attack or network exploit. Even if the attacker tries to exploit a position in the network he thinks is good, but with the help of the model proposed in this study, the position the attacker thinks is simplified will be able to catch him and block the access. So, all the possible positions are stored with the vulnerabilities with the help of placement of intrusion detection sensor.

3.3 Attack Graph from the Network

The attack graphs created inside this study lead to the identification of all the vulnerable paths that can be used for the hardening of the network by the placement of sensors at the desired locations. These locations can be variable and change from network to network. The creation of vulnerability assessment can be done with the help of various vulnerability scanner tools. However, the generation of the adjacency matrix and the mathematical calculation needs to be done with the help of different computer vulnerability scorer tools. The attack graph creation algorithm is shown below:

| Algorithm – Attack Graph Creation | | | | |
|---|--|--|--|--|
| 1. Generate Attack Path (Graph g, Goal) | | | | |
| 2. Input: as Directed Acyclic Forward Reachable Graph | | | | |
| 3. Output: Generated Attack Paths 4. | | | | |
| 5. Initialize stack pointer sp=0. | | | | |
| 6. do | | | | |
| 7. Find all exploit sets that satisfy the Goal. | | | | |
| | | | | |



Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



The general steps which are included in the network model to identify the vulnerabilities comprise following:

- Identifying all the machines in the network which are under consideration for vulnerability analysis.
- Networks scan for all the machines, and the services to identify the interconnection of the machines.
- Identifying all the critical and less critical services which are vulnerable to attacks.
- Creation of a matrix comprising the machine-to-machine mapping based on which the clustering algorithm can be applied.
- Creation of the attack graph depicting all the vulnerable parts and modelling the exception or rejection of vulnerability path as per the mathematical analysis.

The figure below represents a part of the attack graph for the network used above as a sample.







Figure 6: Attack Graph from the Network

Figure 6 depicts a network attack graph in which ssh_c (0, 1) represents the ssh service from computer 0 and computer terminal1. The edge represents connectivity between 0 and 1, and the number computer is extremely vulnerable to ssh attacks. It is also worth mentioning that rsh_c (0, 1) represents the service propagating from the same computer in the Sample network. The rsh services are also vulnerable to exploitation and should be checked. The two variant blocks which are visible in the diagram need to be checked and sensor placement can be done at the computer (0, 1) path. The identification of all such paths which is are responsible for safeguarding the network is the target of the study. The represented attack graph is a single-step vulnerability assessment. However, a similar approach can be applied towards m- Step vulnerability assessment, which is explained above.

- Calculating all the possible paths from the attack graph will comprise all the points prone to vulnerability attacks in the topology.
- Identifying the block points which are responsible or can be a hazard is towards vulnerability in the entire graph.
- Identifying the points which are reasonable enough for placement of sensors for an alarming situation is at the time of vulnerable attacks.
- Calculation of the risk is involved with the help of the risk matrix. This can be calculated using all the risk factors and the attack graph in unison.



The study, which is focused on this research, leads to the foundation of a very strong mechanism that can help handle all the vulnerabilities that can arise in a network. It will be really helpful for the minimization of the exploitation and saving the network from inappropriate access.

4. Results and Discussion

The study represents a new model for the visualization and the prediction of multiple steps attack graphs in any network. The software vulnerabilities can be identified and handled with the help of vulnerability scanners inside the network hosts in association with the firewall and the attacker's exploitable software codes. A complex attack graph can be created, for M step prediction, as well. As identification of vulnerability in the topology. Tab. 1, shows the exploited services and vulnerabilities in the demonstrative network.

Table 1: Exploited Services and Vulnerabilities in the Demonstrative Network

| Host | Services | Vulnerabilities | OS |
|-------|----------------------------------|---|-------|
| Host1 | WuFTPD, SSH, RSH | sshd buffer overflow, ftp.rhost overwrite | Linux |
| Host2 | ProFTPD,RSH,XTE RM, DATABASE, | ftp.rhost overwrite, local xterm buffer overflow | Linux |

The study that is done in this study refers to all the possibilities in which cyber vulnerabilities can be identified and the attacker can try to discover all the attack paths in a network. However, all the results may not be verified with the help of the demonstrator model. A thorough, in-depth analysis is required to mitigate all the potential risks and the attacks that are possible. Tab. 2, shows the cross-mapping between machines in the demonstrative network.

Table 2: Cross - Mapping between Machines in the Demonstrative Network

| Relation | Host0 | Host1 | Host2 |
|----------|-----------|-----------|-----------|
| Host0 | Localhost | FTP, SSH | FTP |
| Host1 | Any | Localhost | FTP |
| Host2 | any | FTP | Localhost |



Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495

The attack graphs shown in Fig.6, lead to identifying all the vulnerable paths used to harden the network by the placement of sensors at the desired locations. These locations can be variable and change from network to network. The creation of vulnerability assessment can be done with the help of various vulnerability scanner tools. However, the generation of the adjacency matrix and the mathematical calculation needs to be done with the help of different computer vulnerability scorer tools. All the vulnerability paths that are identified as critical should be placed with sensors to isolate the intrusion. The problem stated in this particular research comprises many paths as the size of the network increases. It can be assumed to be an NP-Hard problem. We can simulate a similar problem regarding the set cover problem. And, in this case, we proceed with the greedy approach to determining an optimal network path rather than calculating all of the vulnerabilities at all of the paths, which may take more time and result in the integration of additional hardware in the form of sensors. Identified Attack Paths in the study shows the following problems and placement of the sensors can be done based on the paths observed.

Attack Path 1: {ftp_rhosts(0,2)} \rightarrow {rlogin(0,2)} \rightarrow {local_bof(2,2)}

Attack Path 2: {sshd_bof(0,1)} \rightarrow { ftp_rhosts(1,2)} \rightarrow {rlogin(1,2)} \rightarrow {local_bof(2,2)}

Attack Path 3:{ftp_rhosts{0,1}} \rightarrow {rlogin(0,1)} \rightarrow {ftp_ rhosts(1,2)} \rightarrow {rlogin(1,2)} \rightarrow {local_bof(2,2)}

The analysis and discovery of various critical services running on host machines. Priority of services running over hosts to avoid exploits shown in Fig. 7., and Path depth traversal increase in the vulnerability as shown in Fig. 8.



Figure 7: Priority-based Critical Processes





Figure 8: Traversal Depth in the graph.

5. Conclusion

The method presented in this study is a model that represents the network as part of the attack graph, which consists of different types of vulnerabilities other than services. After identifying all the services in this regard, the computing machines can be secured with the help of placing certain sensors and the system can be considered to have more security against the exploit. The proposed method visualizes and predicts complex multi-stage cyber-attacks. Traditional graph-centric modeling and adjacency matrix are used. The prediction for the vulnerabilities in the network can be found using this methodology. The principal analysis combines the important point that the attacker will always attack a site with many vulnerabilities for exploitation. This approach is continued with an enhanced version of network hardening, which identifies the areas where exploitation is possible and implements prediction parameters that include certain sensor-based studies. It makes correlation and prediction very simple to secure the network best. The attack graphs can be created and studied for further placement of vulnerability assessment tools. However, the geographical assessment can be done with the help of resources and powerful computing units. The study presented a model in this research that leads to a robust vulnerability analysis based on the network's topology. The creation of the attack graph makes it easy to identify grey areas and the research points. Thus, it is conducive to ensure cybersecurity and manage the network with the help of M-steps analysis.



6. Acknowledgment: The authors sincerely acknowledge the support from Majmaah University, Saudi Arabia for this research.

7. Funding Statement: The authors would like to thank the Deanship of Scientific Research at Majmaah University for supporting this work under Project Number No -R-14xx-4x.
8. Conflicts of Interest: The authors declare no conflict of interest.

9. References

- Mishra. S., Sharma. S.K. and Alowaidi. M.A. (2021). Multilayer self-defense system to protect enterprise cloud," *CMC-Computer Materials & Continua*, vol. 66, no. 1, pp. 71-85.
- Gupta. R., Tanwar. S., Tyagi. S., and Kumar. N. (2020). Machine learning models for secure data analytics: a taxonomy and threat model," *Computer Communications*, vol. 153, pp. 406-440.
- Mishra. S., Sharma. S.K., and Alowaidi. M.A. (2020). Analysis of security issues of cloud-based web applications,". *Journal of Ambient Intelligence and Humanized Computing*, pp.1-12.
- Mishra. S., and Alowaidi. M.A., Sharma. S.K. (2021). Impact of security standards and policies on the credibility of e-government,". *Journal of Ambient Intelligence and Humanized Computing*, pp.1-12.
- Sarker. I.H., Abushark. Y.B., Alsolami. F. and Khan. A.I. (2020). Intrudtree: a machine learning based cyber security intrusion detection model," *Symmetry*, vol.12, no.5, pp.1-15.
- Mishra. S. (2020). SDN-based secure architecture for IoT," *International Journal of Knowledge and Systems Science (IJKSS)*, vol.11, no,4, pp. 1-16.
- Aldweesh. A., Derhab. A., and Emam. A.Z. (2020). Deep learning approaches for anomaly-based intrusion detection systems: A survey, taxonomy, and open issues," *Knowledge-Based Systems*, vol.189, pp.1-19.
- Husak. M., Komarkova. J., Harb. E. B., and Celeda. P. (2018). Survey of attack projection, prediction, and forecasting in cyber security," *IEEE Communications Surveys & Tutorials*, vol.21, no.1, pp.640-660.





- Liu. J., Lu. H., Wang. M. Chen J., and Zhang. Y. (2020). Macro perspective research on transportation safety: an empirical analysis of network characteristics and vulnerability," *Sustainability*, vol.12,no.15, pp.1-17.
- Ghadi. M., Sali. A., Szalay. Z., and Torok. A. (2020). A new methodology for analyzing vehicle network topologies for critical hacking," *Journal of Ambient Intelligence and Humanized Computing*, pp.1-12.
- Liu. S., Yu. Y., Hu. W., Peng. Y. and Yang. X. (2020). Intelligent vulnerability analysis for connectivity and critical-area integrity in IoV." *IEEE Access*, vol.8, pp.114239-114248.
- Lallie. H.S., Debattista. K. and Bal. J., (2020). "A review of attack graph and attack tree visual syntax in cyber security," *Computer Science Review*, vol.35, pp.1-41.
- Pirani. M., Taylor. J.A. and Sinopoli. B. (2021). "Strategic sensor placement on graphs," Systems & Control Letters, vol.148, pp.1-8.
- Cinque. M., Della. C. and Pecchia. A. (2020). "Contextual filtering and prioritization of computer application logs for security situational awareness," *Future Generation Computer Systems*, vol.111, pp.668-680.
- Stergiopoulos. G., Dedousi. P. and Gritzalis. D. (2021). "Automatic analysis of attack graphs for risk mitigation and prioritization on large-scale and complex networks in Industry 4.0," *International Journal of Information Security*, pp.1-23.
- Pourhabibi. T., Ong. K.L., Kam. B.H. and Boo. Y.L. (2020). "Fraud detection: a systematic literature review of graph-based anomaly detection approaches," *Decision Support Systems*, vol.133, pp.1-15.
- Ibrahim. M., Qays. A., Elhafiz. R., Alsheikh. A. and Alquq. O. (2020). "Attack graph implementation and visualization for cyber physical systems," *Processes* vol.8, no. 1 ,pp.12.
- Sansavini. F. and Parigi. V. (2020). "Continuous variables graph states shaped as complex networks: optimization and manipulation," *Entropy*, vol.22, no.1, pp.1-14.



- Singhal. A. and Ou. X. (2017). "Security risk analysis of enterprise networks using probabilistic attack graphs," *Network Security Metrics*, Springer, pp. 53-73.
- Yang. S., Weirong. C., Xuexia. Z., Chenguang. L., Haifeng. W., Cui. W. *et al.*, (2019). "A graphbased model for transmission network vulnerability analysis," *IEEE Systems Journal*, vol.14, no. 1, pp. 1447-1456.
- Chen. X., Lau. N., and Jin. R. (2021). "PRIME: a personalized recommender system for information visualization methods via extended matrix completion," ACM Transactions on Interactive Intelligent Systems, vol.11, no.1, pp.1-30.
- Ramadan. R.A. (2020). "Efficient intrusion detection algorithms for smart cities-based wireless sensing technologies," *Journal of Sensor and Actuator Networks*, vol.9, no.3, pp.1-22.
- Russo. P., Caponi. A., Leuti. M. and Bianchi. G. (2019). "A web platform for integrated vulnerability assessment and cyber risk management," *Information*, vol.10, no.7, pp.1-17
- Ivanov. D., Kalinin. M., Krundyshev. V. and Orel. E. (2020). "Automatic security management of smart infrastructures using attack graph and risk analysis," In 2020 Fourth World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4) IEEE, pp. 295-300.
- Medvedev. D., Shani. U. and Dori. D. (2021). "Gaining insights into conceptual models: a graph-theoretic querying approach," *Applied Sciences*, vol. 11,no.2, pp.1-29.
- Nia. M.A., Bahrak. B., Kargahi. M. and Fabian. B. (2019). "Detecting new generations of threats using attribute-based attack graphs," *IET Information Security*, vol.13,no.4, pp.293-303.
- Das. S., Gregory. P., Lee. S, Mehta. D and Suri. R. (2021). "Cybersecurity: the need for data and patient safety with cardiac implantable electronic devices," *Heart rhythm*, vol.18, no. 3, pp. 473-481.
- Ghazo. A. T., Ibrahim. M., Ren. H. and Kumar. R. (2019). "A2G2V: automatic attack graph generation and visualization and its applications to computer and SCADA networks,". *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 50, no.10, pp.3488-3498.
- C.Ma, Q. Lin, Y.Lin and X. Ma, (2021). "Identification of multi-layer networks community by fusing nonnegative matrix factorization and topological structural information," *Knowledge-*

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



Based Systems, vol.213, pp.1-14

- Hu. Z., Feiping. N., Chang. W., Shuzheng. H., Wang. R., Xuelong. L. *et al.*, (2020). "Multi-view spectral clustering via sparse graph learning," *Neurocomputing*, vol.384, pp.1-10.
- Liu. L., Luo. S., Guo. F. and Tan. S. (2020). "Multi-point shortest path planning based on an improved discrete bat algorithm," *Applied Soft Computing*, vol. 95, pp.1-10.
- Chen. L., Yue. D., Dou. C., Chen. J. and Cheng .Z. (2020). "Study on attack paths of cyber-attack in cyber-physical power systems, *IET Generation, Transmission & Distribution*, vol.14, no.12, pp.2352-2360.

Copyright © 2022 Mr. Jassir Adel Altheyabi, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC) Doi: <u>https://doi.org/10.52132/Ajrsp.e.2022.33.3</u> Publication Date: 5-1-2022 ISSN: 2706-6495



Cognitive Stylistic Conceptualization of Legal Translation

Dr. Hasan Said Ghazala

Professor of Translation and Stylistics, Department of English, College of Social Sciences, Umm Al-Qura University, Saudi Arabia

Email: <u>hsghazala@uqu.edu.sa</u>

Abstract:

Among the newly developed ideas in the relationship of translation to style is the strong link between translation and cognitive stylistics. The result of this link is the introduction of cognitive conceptualization to translation as one way of comprehending and rendering meaning of the SL into the TL. On the other hand, it can help solve some problems of legal translation based on cognitive cultural conceptualization of legal terms and expressions.

This paper is an attempt to introduce new clues for sorting out a number of legal terminology in the light of latest cognitive approaches to the conceptualization of style which can be applied to legal language in the translation between the two languages, Arabic and English. This is achieved through introducing cognitive stylistic approaches to the conceptualization of the style of legal language in translation and how untrodden ways of legal meanings and implications can be traced and unearthed in the process. The paper ends up with some conclusions about suggesting way-out solutions to several problems of legal translation between the two languages concerned, to be put in use later by legal translators.

Keywords: Cognitive, Conceptualization, Style, Stylistic, Legal translation, Legal language.



Publication Date: 5-1-2022 ISSN: 2706-6495

Introduction: Conceptualization of Style as Choice

Style is nowadays defined in terms of a linguistic choice in the first place. A linguistic choice is made by the writer on the basis of options available in language. These options are in other words potential cognitive conceptualizations available to writers in general. Hence, style is the total options available in the syntactic, semantic, phonological and pragmatic systems of language in particular. In this sense, expression and content "can be viewed as a matter of choice" (Leech and Short (1981: 29). They point out that a myriad of stylistic possibilities (e.g. choices of potential conceptualizations) are available in language, and differing choices in one clause can indicate varying 'conceptualisations' of the same event (p. 191). As also declared by Traugott and Pratt (1980: 34), the more we understand the stylistic choices available in the language system, the more we appreciate the infinite possible variety and combinations of these choices. They introduce the pioneering idea that links the concept of style as choice to 'mind style' and, hence, to meaning. They argue that mind style is appropriate where consistent stylistic choices are made through a text.

In Carter's view, style "results from a simultaneous convergence of effects at a number of levels of language organization" (in D'haen (ed.), 1986). Further, An interesting differentiation between language and style in terms of choice is made by Traugott and Pratt (1981: 29). Language is the sum total of the structures available to users, whereas style concerns the characteristic choices in a given context. Thus, style consists of "choices made from the repertoire of language" (Leech and Short, 1981: 38). It is a type of domain in the sense of the certain choices made by a particular writer, in a particular genre, in a particular text. Style, then, may be defined in terms of the variant linguistic choices made in the text by the individual author, which are in effect stylistic choices made in preference to others potentially available in a language system. In theory, every stylistic/linguistic choice is in some way functional (i.e. cognitively conceptualized).

A new trend of stylistics, cognitive stylistics, has emerged in the past fifteen years. Boase-Beier, maintains that cognitive stylistics "...explores the notion of style-as-mind..." (2006: 75). Mind style has been seen by Fowler as "any distinctive linguistic representation of an individual mental self". The term was originally introduced by Fowler, who defines it precisely as "cumulatively consistent structural options, agreeing in cutting the presented world to one pattern or another, give rise to an impression of a world-view, what I shall call a 'mind style" (1977: 145).



Boase-Beier has not gone too far from this notion of mind style by distinguishing it "as a textual feature from the corresponding cognitive state which can be attributed to it …" (ibid.: p. 76). Simply put, style as mind is a way of conceptualizing language and style in the sense that our choices represent certain concepts of ours in a certain text and context. Consequently, any stylistic /linguistic choice is an expression of concept –be it overt or covert- that has to be considered in our comprehension of its meaning.

Thus, conceptualization is seen as the body of formally represented knowledge of objects, concepts and other entities that are assumed to exist in some area of interest and the relationships that hold among them" (see Genesereth and Nilsson 1987; Madsen and Thomsen 2009; Gómez Gonález-Jover especially 2006: 219. In Boase-Beier, 2006). No text has ever been written or survived in vacuum, or directed to anything else but mankind. This means readers have their rights to read and interpret the text in their own terms of mind, culture, social and religious conventions, ideology, personal experience and background common knowledge of the world. They have a sufficient amount of freedom to understand and construct the writer's stylistic choices in that large context of theirs, keeping an eye on the author's choices and assumed intentions, however indirectly. As Fowler argues, style is not just a question of different ways of saying or expressing the same thing (in Boase-Beier, 2006: 53). Stylistic choices "reflect a speaker's (subjective) choice of a given conceptualization", and are a reflection of different content rather than different expression (see also Leech and Short, 1981). Because stylistic choice is optional to speakers, or writers, it is telling about the person who uses this very particular choice. A choice is made from those structures that mind universally makes available for language users. Such a view of style as mind is a cognitive approach of conceptualising stylistic choices that has left the door wide open for different readings and different interpretations of the speaker's choices - or concepts - by different readers in different cultural and ideological settings.

As to the translator, he/she is after all a reader, a careful and informed reader, who also has his/her own style and stylistic choices, mind, socio-cultural background, ideology, experience and knowledge of the world. More recently, Semino talks of "the social environment of translation" (2007) (see also Tyulenev (2014) on the strong ties between translation and sociology). A pragmatic view of a translator is he/she is a reader and a communicator. He/she reads the source text with the aim of constructing what he/she perceives as the text's meaning - rather than reconstruct the author's meaning - to construct it this time in the target text.



By constructing the source text's meaning in the target language, the translator has an ambitious aim of producing the same potential effects on the target text readers that reflect those produced on the source text readers, though with variations (see also Ghazala, 2011 and 2018 for further discussion).

Conventionally speaking, within translation studies, the process of translation has been described in terms of gain, loss, and betrayal, thus, minimising translation to a mere reproduction, or reflection of an effect, an intention, or a message. Now the process of translation itself has been receiving the greater amount of focus in cognitive studies of translation. It is a process of interaction in a new context, a new reading, a new writing from a cognitive/mental perspective of style. Translation to many contemporary translation theorists (see Semino, 2007.) is *a form of writing and perhaps new conceptualization of the original through its stylistic aspects.*

Cognitive Conceptualization of Legal Style

Regarding translating the cognitive style of conceptualization of legal language, the following points can be put forward to consider:

This series of conceptualization is still going own to generate new concepts related to the root. For example, "criminal libel" (تشهير جنائي) is a new conceptualization that is related to the publication of a defamatory matter as by printed statement or a picture usually in the newspaper or other mass media. On the other hand, each of these concepts are supposed to be taken by readers and translators on its own as a conceptualization that is independent of "crime" for it is different from it. A case in point is "criminal conversation" (فجور(مع امرأة "crime" for it is different from it. A case in point is "criminal conversation" (متروجة أو رجل متزوج)



(حدیث/محادثة/کلام), but it is a conceptualization f a different type of crime, as also stated by Bajcic who rightly notes that "the process of conceptualizing one and the same legal term in different legal fields does not always proceed smoothly"(2011).

(2) The principle of proportionality is one of the basic features of concepts (see Bajicic, 2011). This very principle allows for generating newborn concepts that represent new dimensions of conceptualizing words. It is based on the fact that "nothing is absolute, everything is relative, except God." Hence, new derivations are produced from each word. This calls for relativity principle of language and thought proposed by Whorf (1956) and Sapir (1949). It partly consists of (i) Linguistic Determinism; and (ii) Linguistic Relativity. According to linguistic determinism, language determines thought. However, linguistic relativity states that language encodes different distinctions (see Jakobson, 1960; Crystal, 1987; Malmkjær, 2005; and Boase-Beier, 2006 for further details). Sapir and Whorf maintain that each language involves two interplaying types of aspects: the particular, cultural-specific aspects as a unique way of viewing the world, and *the universal* aspects which languages may share. (See Ghazala, 2011: 137-9 for further details). Hence, the concept of relativity of translation encapsulates the relative nature of the meaning transported into the target text, as opposed to one absolute, perfect and invariable meaning of the source text. In contemporary cognitive studies of style, and as indicated above, meaning is constructed mainly on the basis of the conceptualisation of stylistic choices of the source text and their effects and implications. This cognitive enterprise draws heavily on the views of some translation theorists like Hyde, Lecercle, Venuti, who accept that different languages embody different kinds of thinking. This is not a barrier to translation if pragmatic and contextual factors are taken into account (which is what cognitive approaches to language and translation do). More so, one thinks in a different way in every language, for one adopts the particular mindset of that language (see Nord (1997), Gutt (2000) and Boase-Beier (2004a, 2004b and 2006).

In legal translation the concept of proportionality (or relativity) is useful at translating between two languages as many SL concepts may be conceptualized in a relative (or approximate) way (see Ghazala, 2020 and Ghazala 2022 (forthcoming) on the proximity principle of legal translation).



The word "crime", exemplified above, is supposedly an absolute concept that is generally conceptualized in Arabic into the absolute straightforward equivalent (جريمة). Now, is the concept applicable identically to all types of crime in both languages? The answer is definite NO, for not all crimes in English are crime in Arabic, and vice versa. Killing, stealing, assaults of all types, cheating, corruption, money laundering and so on are all crimes in the law of both languages and cultures. However, adultery is a crime in Arabic law, not in English law. By the same token, getting married to more than one woman at the same time is a crime in English (called "polygamy"), whereas in Islamic law, it is legal. On the other hand, the concept itself, "crime" (جريمة) is proportional in volume, degree, resonance and punishment. For example, if one is rich and does not help one's poor parents and relations, one is described as committing a moral crime in an Arab Community and has a negative social resonance, but not in an English community. On the other hand, refusing to help one's poor relatives is less in volume than assaulting them, etc. All these considerations of proportionality of concepts should be taken into account by legal translators between English and Arabic.

- (3) Law is composed of words or labels, but these are different from the concepts that are the building blocks of law. A single label can refer to multiple concepts, or multi-meanings of polysemy. In other words, words that have more than one meaning have different ways of conceptualization. For example, "right" (بعين) means one thing when giving directions; another thing (حــح) opposing to wrong; yet quite another (حق) when discussing the legal system. Even within the law, the concept of a right is different when thinking about an individual's freedom from torture than when talking about Mother Nature's right to remediation (see also Cao, 2010, and Alcaraz *et al*, 2002).
- (4) Each legal concept might have <u>subconcepts (مفاهيم فرعية</u>). "Murder", for example, is killing with (1)malice (الحقد), (2) aforethought or intent (النية المبيتة); (3) motive(s) (الحقد) behind killing and (4) device (أداة) for killing. This means that law is composed of concepts and subconcepts, structured together in particular ways.
- (5) Legal concepts should be resonant in the sense that they must be collocable in a way that they are distinct from the ordinary meaning attached to the same terms. Each label (i.e. word) goes with the appropriate word, or, the right word with the right word. This is a direct reference to legal collocations.



A case in point is "Cross-examination" which can be translated into (تحقيق تقاصّ؛ التحقيق مع Only the last one (followed). Only the last one (followed by the penultimate version 5) can be usually used to translate the original concept appropriately in legal context for the other translations involve different dimensions of conceptualization, as shown below:

- (1) تحقيق تقاصّ: cross-investigation in general
- (2) التحقيق مع الشهود: investigation with the witness
- (3) عساءلة الشهود (3) calling the witness to account/impeachment
- asking questions to the witness :توجيه أسئلة للشهود (4)
- discussing the witness :مناقشة الشهود (5)
- (6) استجواب الشهود: questioning the witness

The first is vague, uncommon, unknown and not limited to legal language. The second suggests a kind of intelligence/police investigation, which is not applicable to the SL meaning. The third, on the other hand, implies bringing some accusation to the witness which is an irrelevant concept in this context. The fourth represents a subconcept, or a semiconcept of the original for the cross-examination does not involve asking the questions he/she has to answer, but also it involves reactions and maybe questions asked by the witness. However, number 5 is the closest to the SL concept ad meaning for the witness is supposedly engaged in a kind of quiet dialogue or discussion. As to the last one, it means that the witness is being questioned certain questions to answer freely with no pressure from anyone and has the right to answer a question or not, and also has the right to enquire about something. Above all, this is the most common, natural and appropriate collocation that has a special resonance, used frequently and intuitively by men of law and laymen alike. Indeed, it is one of the popular phrases in the daily sessions of courts among other ناد على الشاهد / الشهود لاستجوابهم؛ يمكن لمحامي الدفاع استجواب الشاهد/ الشهود؛ تم related phrases like: Thus, the whole collocation is a special conceptualization ensuing / بعد استجواب الشهود...) particular subconcepts or presuppositions associated with it.

Corruption is also unquestionably a resonant and fecund concept, in that it is intuitively undesirable to most observers and conveys a rich array of negative meanings.



This rich array is a part of the problem because corruption can mean many different things and many different types of legal crimes. So the term has been-defined in many different ways e.g. bribery, cheating, blackmail, embezzlement, money laundering, smuggling, theft, fraud, graft, extortion, abuse of discretion, favouritism/ nepotism, clientelism (i.e. client politics), networking, dishonesty, criminal offence of some kind, etc.).

- (6) The domain of legal concepts is the legal system; it is not meant to encompass anything outside it. Common-law marriage(الزواج الشرعي/القانوني/حسب القانون) refers to the idea that the marriage is legal, even if not formally recorded (as is the case with many marriages in the Arab and Muslim countries). Consistency requires that a concept carry the same meaning in different empirical contexts.
- (7) Some legal concepts can be limited to very narrow conceptualizations of technical applications. For example, in thinking about different types of political "regimes", one might distinguish authoritarian regimes from democracies, or might alternately look at particular subtypes within each category: electoral authoritarians, totalitarians, military regimes, junta, dictators and absolute monarchies, or presidential and parliamentary democracies.
- (8) Sometimes concepts are defined by their neighbouring concepts as is the case with legal collocations, where each couple or triple of words form a mini-context that delineates a legal concept and its meaning. For example "pass" has several meanings, but when it collocates with "law" it produces a new legal concept related to setting a new law officially (أيسن قانوناً), etc.
- (9) There are underlying conceptualized interrelationships among different concepts. One example is the relationship between democracy and other concepts:
 - (1) Does democracy increase economic growth?
 - (2) Does race correlate with voting behaviour?
 - (3) Do people behave rationally in their investment decisions?
 - (4) Are military alliances stable across time?

These are examples of another possible extension of conceptualization of a concept to subsume different domains and fields of knowledge which have some relevance to the same concept however indirectly.



In translation, all these concepts, subconcepts and new conceptualizations should be taken care of by legal translators due to the importance of differentiating between various conceptualizations that are variably different from time to time and from one language to another. Hence the significance of the style of conceptualization in legal translation.

Conceptual vs. Functional Approach to legal Translation

Nida (1964, 1969 and 1982, 2001) puts forward a theory of functional equivalence which has a great influence on translation, including legal translation. The term 'functional equivalence' highlights the impact the message has on the target language and the source language reader. In this regard, Šarčević (2000: 238) divides functional equivalence into three groups: near-equivalence, partial equivalence, and nonequivalence. The method the legal translator chooses depends on the degree of equivalence within the concept, while near equivalence may require the translator to find a phrase in the target language with the same meaning (2000: 238, in ibid: 204).

Based on Stolze (2013 & 2011:105–127), Piecychna (2013) adopts the functional equivalence method in legal translation. Functional equivalence means the interrelations and the communicative values between the (SL) and the (TL) words, sentences and terminology (Nord 1997:138). "The translator uses the functional equivalence when translating legal terms from one legal system in a given language and the other legal system of the target language", (see Cao 2007:32, and 2010 for further details). If there is a language that uses multiple legal systems such as Arabic Language, the translation between two different legal systems using the functional equivalence is a must. One practical example is "Magistrate" which holds different connotations within the same language, as it may mean (Judge), (Key Law Maker) and (Man of Authority). Yet, are these meanings the exact functional equivalence with respect to the legal system concerned? The translator needs to dig deep in the (SL) legal system terminology in order to extract the exact resemblance of the meaning and functional equivalence of the legal term in order to be accurate in translation. The Arab Translator might convey a different meaning of "Magistrate" which is (the investigation judge تالمحقق) or (the investigation principal قاضى التحقيق / المحقق), which is an inaccurate translation and not the functional equivalence. Yet, in Saudi Legal system, the word "Magistrate" does not exist as far as the functional equivalent technique is concerned for there is no such equivalence embedded in the legal system of the country.



Instead, there is a committee that plays the role of a judge or magistrate instead of one legal authoritative individual. Thus, the legal translator should constantly trace the functional equivalent among languages as much as their different legal systems.

As to conceptualization of legal translation and its relevance to the functional equivalence, it seems to me that the search for the functional/cultural equivalence is not dissimilar to, and does not contravene at heart with the cognitive conceptualization of the meanings of legal terms especially those described as unfindable, or culturally, religiously, politically or socially different. That is, the functional/cultural equivalence is in other words a TL-oriented translation of an SL legal term, and cognitive conceptualization is a reference to rendering meaning in accordance to the TL values, culture and mindset. Hence the closeness of functional and cognitive approaches to legal translation.

Translating Legal Cognitive Conceptualization:

Problems and Solutions

Following are sample examples of some problems of translating legal conceptualization in application, followed by their suggested solutions:

Problem 1: Legal translators might find it difficult to understand the concept and process of conceptualization of words in the first place, and whether it is universal or local / cultural in the sense that both the SL and the TL have the same or different conceptualization of language.

Solution: words are usually identified as ideas or concepts. For example, "law" is a word and at the same time an abstract concept in that it is a group of letters and sounds that signifies (i.e. the signifier(المدلول عليه/الفكرة)) a concept in language (i.e. the signified (الدال/الإشارة)). These words have been already conceptualized in language and have thus become arbitrary basic concepts from which new concepts and conceptualizations are generated, derived or invented on the basis of social, linguistic, ideological, cultural, political, individual and religious factors. This means that conceptualization is not universal, but local/cultural. However, many concepts and conceptualizations can meet universally, others might cross swords with other languages and cultures. More likely, the majority of legal concepts and conceptualizations are universal. Yet, local and cultural conceptualizations are lurking in any language and culture (see examples below).



Here is a detailed simplified example of how words are conceptualized culturally to become a part of our prior knowledge and experience of life, and how they breed new concepts and conceptualizations in a cognitive stylistic process and knowledge (see also Ghazala, 2016: 31-2):

(call for congregational prayer) (أقم الصلاة)

Firstly, to read this example, prior knowledge of Arabic is required. Readers who are not familiar with Arabic are also invited to explore the following account of the cognitive process of understanding and interpreting the concept of starting a congregational prayer. To understand this statement, the reader has to be equipped with knowledge of Islam according to which 'prayer' (Salat) is ordained five times a day at a specific time. Furthermore, he/she has to know beforehand that there are two ways of praying: alone (usually at home) and congregationally (usually at the mosque, starting from two people on). He/she also must already have a good idea about MOSQUE and how congregational prayers are held: a leader (or Imam) standing in the middle in front of worshipers, who line up right behind him in shoulder-to-shoulder rows and do what he does right after him concerning the start, units (rak'aas) and end of the prayer. As to the notion of MOSQUE, it should be a part of the stored knowledge of the reader: a large hall, usually rectangular, well-carpeted, well-lit, clean, tidy, quiet, with a pulpit and a prayer niche (or Mihrab) in the middle of the inside front for the Imam, and usually with a high minaret constructed in the outside middle or on one of the outside corners of the mosque.

Now there might be variations on this basic knowledge of the notion of the MOSQUE. For example, some mosques are two floors, one (usually downstairs) for men, another (usually upstairs) for women. A number of mosques have two or more minarets which may vary in height. Usually mosques are air-conditioned and have loudspeakers. However, these facilities may not be available in some mosques. Wall decorations, wall-hanged and/or wall-carved verses from the Holy Koran (the Holy Book for Muslims) are different, sometimes sharply, from one mosque to another. Several mosques have shops attached to them, but the case may not be so for many others.

Yet, there can be a quite unusual cognitive experience of the notion of MOSQUE. I remember having had such an experience some years ago in 1986 when I was preparing my PhD Thesis in Stylistics at the University of Nottingham, UK, with a then newly constructed mosque at the University. There was a fridge inside the mosque, a help-yourself fridge crammed with chocolate bars and soft drinks available to worshipers, charged, or free of charge!



A unique experience with the notion of MOSQUE is now available for everybody to watch on TV worldwide; that is, the live pictures of the Holy Mosque (i.e. Al-Haram Mosque) at Makkah Al-Mukarrammah of Saudi Arabia. It offers an exquisite cognitive experience of a completely different mosque, especially with respect to architecture, inside and outside shape, mixed lines of male and female worshipers praying, circumambulating around the Holy House of God, Kaaba, and galloping between the two Mounts of Safa and Marwah (i.e. Sa'i) (especially at the times of Hajj and Omrah, or mini-Hajj) and lining of worshippers in circular rows around the House of God, Kaaba, the prayer direction for all Muslims all over the world, which is in the centre of the Holy Mosque.

Thus, there are many concepts, conceptualizations and newly conceptualized concepts that have been formed, constructed, construed or invented on the way over time and new developments of life and the world. However, although all of them are interrelated, they have become concepts and conceptualizations of their own understood and used as such. A similar process can be applied to words and concepts and generating new concepts of other fields of knowledge and types of language including legal language.

Problem 2: an embarrassing situation can be come across by unheeded legal translators who might have no clear idea about differences in conceptualization of some words or concepts in the target language such as incriminating/non-incriminating some acts like adultery, wine drinking, polygamy, etc. Therefore, they translate SL terms literally or wrongly without attending to the sharply different conceptualization of their counterparts in the TL culture.

Solution: cognitive conceptualization of terminology is not necessarily the same in both languages involved, as is the case here with English and Arabic. Therefore, legal translators should be aware of that to avoid committing foolish mistakes by adopting the SL cultural concepts that are at odds with our conceptualization of these concepts. Adultery is a crime in our law and religion of Islam, whereas it is not in English law and religion; drinking wine is a daily practice of the English people and, hence, nothing is illegal about it. However, in Arabic law and religious and social culture, wine drinking is illegal and religiously forbidden with supposedly strict punishment. By analogy, polygamy is a crime in English and American laws, but getting married to more than one woman – up to for – at the same time is perfectly legal and religious. A father who takes his son's money is not a thief, whereas in English law he is.



At translating these and other terms and words that are conceptualized differently in the TL, the translator should take that into account by translating its implied meaning, or rendering it literally followed by an illustrative comment, or a footnote if long. Take, for example, "polygamy/bigamy': it is translated heedlessly into (تعدد الزوجات) in Arabic, but its conceptual meaning is which makes a big difference of conceptualization of legal meaning. The same الزوجات والأزواج) applies to "polygyny" which has to be translated not into (تعدد الزوجات) but rather into (تعدد) الزوجات). According the Free Legal Dictionary online, the three terms, polygamy, bigamy and polygyny, are described each as a crime (جريمة), felony (جناية) and offense (جريمة) in American and English laws. The American Model Penal Code section 230.1, for example, provides that a person is guilty of the third-degree felony of polygamy if he or she marries or cohabits with more than one spouse at a time in purported exercise of the right of plural marriage. The crime is punishable either by a fine, imprisonment, or both, according to the law of the individual state and the circumstances of the offense. The crime of polygamy is deemed to continue until all cohabilitation with and claim of marriage to more than one spouse terminate. ... The law in every state prohibits a man or a woman from being married to more than one living person at a time. The crime of having more than one current spouse is called either bigamy (having two spouses) is a subset of the crime of polygamy (having more than one spouse). (see https://legaldictionary.thefreedictionary.com/Polygamy)

For all these reasons, the English terms express concepts and conceptualizations that are at odds with the TL counterparts which have to be precisely translated in accordance with the TL (i.e. national or cultural) legal conceptualizations of the concepts of the original. This means that the TL laws are not subdued to the SL laws in translation.

<u>Problem 3</u>: is legal terminology all in all culturally conceptualized? If so, the problems of translating it into Arabic will be daunting indeed, not to say impossible at least for some translators.

<u>Solution</u>: the answer is definite 'No!' Linguistically speaking, legal language is mainly universal, partly cultural. This is a fact about language, any language. In other words, languages are culturally (or locally / nationally) conceptualized only. Apart from the so-called international laws of international organizations like those of the United nations, judicial systems are cultural in the sense that each system is local and national, based on, designed for, and aimed at its local/national community. It cannot be applied as such in another country to a different community.



For example, the British law cannot be applied in, say, Saudi Arabia, to the Saudi Community due to many differences of conceptualization including different cultural conceptualizations of all types: religious, social, political and linguistic. However, in the translation of legal English Language, we translate language in the conceptualization, as some may insist (i.e. we translate a judicial system's conceptualization, as some may insist (i.e. we translate a judicial system into another judicial system). This is a purely theoretized over-statement. We translate the language that carries the meanings, concepts and implications of the British system into Arabic, with both translators and readers bearing in mind that it is in a British system context, not Arabic context.

Take for example the phrase "letter of advocation", which is a part of the Scottish law. We translate it into Arabic as (أمر قبول الدعوى الاستندافية), preceded, or followed by the classifier, الأسكتلندي) By doing so, we give the clear meaning of the phrase in its locally conceptualized Scottish context. Nothing else is required from the translator other than translating the meaning of the phrase accurately and properly in its particular conceptual context, be it cultural or not. The fact about translating legal language is that it is mainly universal and, hence, pose the normal problems of translating appropriately and accurately into the target language. The remaining smaller part is culturally and locally conceptualized, which has to be translated with careful attendance to the cognitively cultural factor and how to render its conceptualized meaning into Arabic-conceptualized sense, using translation procedures like transference, paraphrase, classifier, naturalization, cultural equivalent, and so on.

On the other hand, cross-culturally conceptualized legal systems are frequent these days as countries borrow laws from one another for some specific reasons. One of these reasons is colonization of Arab countries which were colonized by France (like Syria, Lebanon, Algeria, Morocco and Tunisia) and, consequently, adopted many things from the French law; and countries that were occupied by the British, were influenced by the British law, and so on. In sum, Whatever this culturally conceptualized factor may be, it is no doubt TRANSLATABLE in some way, whether into Arabic or any other target language. Nothing is untranslatable; everything is translatable! No doubt, translating conceptualizations from one language into another is not insuperable.



Conclusions and Findings

Several conclusions can be drawn from this research paper. One is that cognitive stylistic conceptualization of language in translation is a fact that we can make use of in legal translation to help us suggest further solutions to some problems of translating legal language. Another conclusion is that we cannot turn a blind eye to new findings of other disciplines like cognitive stylistics and apply them to legal translation, as translation is an interdisciplinary field of knowledge. A third conclusion is that conceptualization is not quite different from functionalization of legal translation for both approaches are TL-oriented and target readership-centered , searching for a locally/nationally conceptualized equivalent of the meaning of an unfindable, or different SL term/meaning. A fourth and final conclusion and finding is that by cognitive conceptualization of legal translation, translators can touch upon more pathways of solutions to the problems of translating legal language, especially those concepts, meanings and implications that are either clashing, different or, generally. unfindable in the TL.

References

Alcaraz, E. and Hughes B. (2002). *Legal Translation Explained*. St. Jerome Publishing. (Published 2014 by Routledge).

Bajcic, Martina (2011). Conceptualization of legal terms in different fields of law: the need for a transparent terminological approach.*Research in Language*, **2011**, **vol. 9.1** • DOI 10.2478/v10015-011-0001-5 (pp.82-93).

Boase-Beier, J. (2006) *Stylistic Approaches to Translation*. St. Jerome Publishing: Manchester, UK & Kinderhook, USA).

Boase-Beier, J. (2004a). 'Saying What Someone Else Meant: Style Relevance and Translation'. *International Journal of Applied Linguistics*, 14(2):276-287.

Cao, D. (2007). Translating Law. Multilingual Matters Ltd. Clevedon, Buffalo and Toronto.

Cao, D. (2010). Handbook of Translation Studies. John Benjamins.

Carter, R. (1987). A question of interpretation: an overview of some recent developments in stylistics. In D'haen, Theo (ed.) (1986). *Linguistic and the Study of Literature*. Rodopi.

Crystal. D. (1987). *The Cambridge Encyclopedia of Language*, Cambridge University Press: Cambridge.

Fowler, R. (1977). Linguistics and the Novel. Methuen: London.





Ghazala, H. (2011). Cognitive Stylistics and the Translator. Sayyab Books: London. Ghazala, H. (2015). Translating Culture: A Textbook, Jedda, Saudi Arabia: Konooz Al-Marifa. Ghazala, H. (2018). The Cognitive Stylistic Translator. AWEJ for Translation & Literary Studies, Vol. 2, No. 1, pp. 4-25 (الموسوعة العربية الأولى للترجمة). The First Arabic Encyclopedia of Translation (الموسوعة العربية الأولى للترجمة) (in Arabic), Jedda, Saudi Arabia: Konooz Al-Marifa. Ghazala, H. (2022) (forthcoming). Proximity Principle in Legal Translation. Gutt, E. (2000). Translation and Relevance, 2nd edn. St. Jerome: Manchester. https://legal-dictionary.thefreedictionary.com/Polygamy) Jakobson, R. (1960) 'Closing Statement: Linguistics and Poetics', in Sebeok, T.A. (ed.) Style in Language, Cambridge: The MIT Press, 350-93. Leech, G. and Short, M. (1981). Style in Fiction: A linguistic Introduction to English Fictional Prose. London and New York: Longman). Malmkjaer, K. (2005). Translation and linguistics. *Perspectives-studies in Translatology*. 13(1):5-20. Nida, E. (1964). Towards a Science of Translation. Leiden, E.J. Brill. Nida, E. and Taber, C. (1969). The Theory and Practice of Translation. Leiden, E.J. Brill. Nida, E. (1982/2001). Signs, Sense and Translation. Pretoria, University of Pretoria. Nord, C. (1997). Translating as a Purposeful Activity: Functionalist Approaches Explained. Manchester: St. Jerome. Piecychna, B. (2013). Legal translation competence in the light of translational hermeneutics. Studies in Logic, Grammar and Rhetoric. 34 (1): 141-159. Šarčević, S. (2000). 'Legal Translation and Translation Theory: A Receiver-oriented Approach', in La Traduction juridique: Histoire, theorie(s) et pratique, Geneve, Universite de Geneve, Ecole de Traduction et d'Interpretation /ASTTI, 329–347. Semino, D. (2007). 'Translation and Society: The Emergence of a Conceptual Relationship', in St-Pierre, P. and Kar, P.(eds), In Translation – Reflections, Refractions, Transformations, (John Benjamins Publishing Company, Amsterdam / Philadelphia), pp. 13-26. Stolze, R. (2013). The Legal Translator's Approach to Texts. Humanities, 2, 56–71. Traugott, E. and Pratt, M. (1980). Linguistics for Students of Literature. Harcourt Brace Jovanovich Inc.



Tyulenev, S. (2014). Translation and Sociology : An Introduction. Routledge, Taylor & Francis: London and New York.

Whorf, B.L. (1956). *Language, Thought and Reality*, (ed.) J.B. Carroll.Cambridge, Mass: MIT Press.

Copyright © 2022 Dr. Hasan Said Ghazala, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC)

Doi: https://doi.org/10.52132/Ajrsp.e.2022.33.4



Construction Solutions of Ordinary and Partial Differential Equations using the Analytical and Numerical Methods

Turkia Dhawi Alqurashi

Master of Mathematics (Numerical Analysis), College of Science, Shaqra University, Saudi Arabia

Email: <u>t.alkorashi@su.ed.sa</u>

Abstract:

In this paper we studied the solution of partial differential equations using numerical methods. The paper includes study of the solving partial differential equations of the type of parabolic, elliptic and hyperbolic, and the method of the net was used for the numerical nods, which represents a case of finite differences. We have two types of solution which are the internal solution and boundary solution. The internal solution is based on the internal nodes of the net. The boundary solution depends on the boundary nodes of the net, in addition to finding the analytical solution of the equations to compare the results. We also discussed solving the problem of Laplace, Poisson, for the importance of these equations in the applied side; Mat lab was used to find the values of tables for the values of border differences. We have derived a new formula for the solution of partial differential equations containing three independent variables.

Keywords: Regular Differential Equations, Partial Equations, Regular Differential Equivalent Solutions.



الملخص:

درسنا في هذا البحث حل المعادلات التفاضلية الجزئية بالطرق العددية. تضمنت الورقة دراسة حل المعادلات التفاضلية الجزئية لنوع القطع المكافئ، والقطع الناقص، والقطعي، واستخدمت طريقة الشبكة للإيماءات العددية، والتي تمثل حالة الفروق المحدودة. لدينا نوعان من الحلول وهما الحل الداخلي وحل الحدود. يعتمد الحل الداخلي على العقد الداخلية للشبكة. يعتمد حل الحدود على العقد الحدودية للشبكة، بالإضافة إلى إيجاد الحل التحليلي للمعادلات لمقارنة النتائج. ناقشنا أيضًا حل مشكلة لابلاس ، بواسون ، ولأهمية هذه المعادلات في الجانب التطبيقي ، تم استخدام معمل Mat لإيجاد قيم الجداول لقيم الفروق الحدودية. لعد اشتققنا صيغة جديدة لحل المعادلات التفاضلية الجزئية التي تحتوي على ثلاثة متغيرات مستقلة.

الكلمات المفتاحية: المعادلات التفاضلية المنتظمة، المعادلات الجزئية، الحلول المكافئة التفاضلية المنتظمة.

Introduction:

The normal and partial differential equations are important in the rehabilitation and application of mathematics and physical, which are connected to sports and engineering science, the electrical and mechanical and sanctuary of the types of normal or partial differential equivalents (Essa, 2019).

There are no general sports methods to resolve differential equations, but there are some ways that can be circulated to a special group of differential equations (Othman & Mahjob, 2016) .The way of differences, which is more famous, and the way of the network is also used, where the essence of this method is to be the mainstream of the regions, where a separate set of points (the contract) is called the so-called network that replaces continuous diabetes to the network and is called the network ducts and as well as replace the derivatives in the differential equation Insurance of the differences in the differences of differences in the differential values of the differential equation were the differences (Morton & Mayers, 2005). The regular differential equation contains a single independent variable by the partial differential equation that has a number of independent variables such as temperature (which is based on two-way variables).

The study of the differential equations in the 18th century began to be reached by the researchers as an example, the Damlambeer, Lagrang, which appear in the issues related to the sound and heat, fluctuations of fluid and flexibility,



the result of the importance of the role of the silver and the physical means of the squad and the awareness of a lot of mathematical and physical mattresses in a well-developed style. The findings of the numerical and analytical revenues of the normative and visual differences and the methods of building them. The number of ways that are based on the risk of irregular equation is easy to deal with it.

The current search seeks to the following:

- Solve and build regular differential equations using numerical roads.
- Solve the partial differential equations using analytical methods.
- Solve the normal differential equations using normal ways.
- Solve the partial differential equations using normal ways.
- Identify the uses of regular and analytical differential equivalents using numerical and analytical roads.

Definition of differential equation:

The equation is a differential equation if it contains derivatives for the approved variable for independent variables and the differential equation is the normal variable that is based on a single independent variable (Lippold, 1980).

Differential equation:

is a system of dollar that achieves differential equation and conveyor of derivatives, in the case of normal differential equations, can solve public and especially solutions, as general solutions to differential equations are solutions that contain many optional constants according to the differential level of the differential equation, the solutions obtained from selected values for optional reactions in the general solution, while individual solutions to differential equations are solutions that can not be obtained from the general solution (Hockney & Eastwood, 2021).

Regular differential equations:

There are multiple varieties of regular differential equivalents:

A. The regular differential equation of the first level and you are following as the following format

 $f(x, y, \dot{y}) = 0$ (1)



Where F is a function in the variables (x, y, \dot{y}) and the formula (1) is called as impressive formatting of normal differential equation, and the regular differential equation can be written from the first time (Essa, 2019):

$$y = f(x, y)$$
(2)
or $M(x, y)dx + N(x, y)dy = 0$ (3)

The function $y = \phi(x)$ is available to the differential equation if the equation is achieved, which is when replacing the y and y` value in $\dot{\phi}(x), \phi(x)$ The equation is realized by the match, so equation F(x, y, c) = 0 complete integration of differential equation and can be obtained through integration of differential curve integration curves, as the scheme of the differential equation process is called full-purpose (Morton & Mayers, 2005).

The requirement is called $y = y_0$, $x = x_0$ or $y(x_0) = y_0 = \varphi(x_0)$ with the primary condition of the differential equation (Mathews, 1992).

Factive differential equations:

The regular differential equation is called if the book is in the form of the following:

f(x) dx + g(y) dy = 0(4)

and the integration of ends of the equation we get the solution (Press et al., 1986).

Numerical methods used to solve the normal differential equations of the first class
 These methods are on the equations that are formulated are

$$\frac{dy}{dx} = f(x, y)$$

the primary requirement $y(x_0) = y_0$, where numerical methods depend on the knowledge of the variable y in the moment of starting x_0 and then launch this point step by step as we are estimated for $x_0 + h$ and y_2 for $x_1 + 2h$ where the growing h-Code is defined as $h = \frac{b-a}{M}$ (Othman & Mahjob, 2016)



Oleer:

This method of national reliability methods depends on giving a hard h values small so that the Tyler series can be deleted $\frac{h^2}{2!}y''(x)$ from the limit that contains the Tyler string of the Tyrler (x + h) which Kalati is known as (Smith et al., 1985): $y (x + h) = y (x) + h\dot{y} (x) + h^2 / 2! y'' (x) + \dots + h^n / n! y (n)$. By deleting the border as of the $h^2 / 2!$ limit, $y(x + h) = y(x) + h\dot{y}(x) = y(x) + hf(x, y)$ where we start from the point (x_0, y_0) and compensation in the relationship above, the system $y_1 = y(x_0 + h) = y(x_0) + h\dot{y}(x_0)$ $y_2 = y(x_0 + 2h) = y(x_0) + 2h\dot{y}(x_0)$

$$y_{n+1} = y_n + hf(x_n, y_n)$$
 $n = 0, 1, 2, 3, \dots, M - 1$

This is the general formula of law of the Auiler in the solution of differential equations

Example: The approximate solution is to the differential equation of y = x + y where y(0) = 0, Take h = 0.2 in the period [0, 1].

Solution

Using the Iuilel law and the requirement y(0) = 0 where $x_0 = 0$, $y_0 = 0$ and the compensation of the law we find that

$$F(x_n, y_n) = x_n + y_n , \quad x_n = x_0 + nh = nh$$

$$y_1 = y_0 + 0.2(x_0 + y_0) = 0$$

$$y_2 = y_1 + 0.2(x_1 + y_1) = 0 + 0.2(0.2 + 0) = 0.4$$

$$y_3 = y_2 + 0.2(x_2 + y_2) = 0.4 + 0.2(0.4 + 0.04) = 0.128$$

$$y_4 = y_3 + 0.2(x_3 + y_3) = 0.128 + 0.2(0.6 + 0.128) = 0.274$$

$$y_5 = y_4 + 0.2(x_4 + y_4) = 0.48 + 0.2(0.8 + 0.489) = 1.747$$

$$y_{n+1} = y_n + 0.2(x_n + y_n)$$
, $x_n = 0.2_n$

The Rogen Metaway of the fourth rank:

The previous OILE method in the solution of differential equations is used in practice as needs a small step (The value of the h must be small) for a reasonable accuracy,





Tyler's triangle of the upper junior split as a general way to solve the differential equations because it needs many derivatives of the reservation y(x) The Rogen Cuta method is preparing from the important ways to find the approximate solution to differential equations that help us get high accuracy with avoiding the need to derive the reservation y(x) The unisex compensation is based f(x, y) on selected points and therefore the general image of the equivalent of the rat mall of the 4th class is as follows (Mathews, 1992):

$$y_{n+1} = \frac{y_{n+1}}{6(k_1 + 2k_n + 2k_{n+1} + k_4)}$$

Where:

 $k_{1} = hf(x_{n}, y_{n})$ $k_{2} = hf(x_{n} + \frac{h}{2}, y_{n} + \frac{1}{2k_{1}})$ $k_{3} = hf(x_{n} + \frac{h}{2}, y_{n} + \frac{1}{2k_{2}})$ $k_{4} = hf(x_{n} + h, y_{n} + hk_{3})$

Using the Rutan Kota 4 way finds the approximate solution to the issue of the primary condition :

y(0) = 1, h = 0.1 $0 \le x \le 1$, y' = -y + x + 1

Disentanglement

The equations of the Kota's cylinder can be written in the following picture:

$$y_{n+1} = y_n + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

By applying the Rome Cacta equivalents where

$$f(x,y) = -y + x + 1$$

 $k1 = f(x_n, y_n)$

$$k_{2} = f(x_{2} + \frac{h}{2}, y_{n} + \frac{h}{2k_{1}})$$

$$k_{3} = f(x_{n} + \frac{h}{2}, y_{n} + \frac{h}{2k_{2}})$$

$$k_{4} = f(x_{n} + h, y_{n} + hk_{3})$$


AJRSP

Which becomes as follows:

$$k_{1} = -y + x + 1$$

$$k_{2} = f \left(x_{n} + \frac{h}{2}, y_{n} + \frac{h}{2} \left(y_{n} + x_{n} + 1\right)\right)$$

$$k_{3} = f \left(x_{n} + \frac{h}{2}, y_{n} + \frac{h}{2} \left(\frac{h}{2} - 1\right) y_{n} + \left(1 - \frac{h}{2}\right) x_{n} + 1\right)$$

$$= \frac{h}{2} \left(1 - \frac{h}{2}\right) y_{n} + \left(1 - \frac{h}{2}\right) x_{n} + 1$$

$$= \left(1 - \frac{h}{2}\right) \left[\left(1 - \frac{h}{2}\right) (x_{n} - y_{n}) + 1 \right]$$

$$K4 = (x_n + h, y_n + hk_3)$$

$$K4 = -y_n + h(1 - \frac{h}{2}(1 - \frac{h}{2}))(x_n - y_n) + 1 + x_n + h + h$$
For each $n = 0, 1, 2, 3, 4, \dots, 9$
For example, when $n = 0$ van:
$$K1 = -y_0 + x_0 + 1 = 0$$

$$K2 = (-0.95y_n + 0.95x_n + 1) = 0.05$$

$$K3 = (-0.9525(x_n - y_n)y_n + 1) = 0.09525$$

$$K4 = -1 - 0.19525 = 0.0525$$
And compensation of these values in the equation:

$$y_{n+1} = y_n + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

We get on the: $y_1 = y_0 + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4)$

$$= 0 + \frac{0.1}{6}(0 + 2 \times 0.05 + 2 \times (1.09525) + (0.09525))$$

= 1.0048375009

Here we see the importance of the Roy Cot Ratio method as a nine way in solving the differential equations:

1



Classification of partial differential equations:

The general state of the differential equations of the second level with two independent engines, the format (Press et al., 1986):

 $F(x, y, U, U_x, U_y, U_{xx}, U_{xy}, U_{yy}) = 0$ (1)

Partial derivatives. U_x , U_y , U_{xx} , U_{xy} , U_{yy} , an approved variable u, independent variables X, y so that any translation of the equation to the function, that the graph of the solution represents U(X, Y) knows the solution of differential equation that the roof function for this function. The equation is said to be linear if the function and all their first class and derivatives are inherited. The linear equation can be written following:

 $A(x, y)xx + B(x, y)u_{xy} + C(x, y)u_{yy} + D(x, y)u_x + E(x, y)u_y + F(x, y)u = R(x, y) \dots (2)$ The amount of D = B2(x, y) - 4((x, y) C(x, y)) is distributed to (2) the equation of the D, so there are three categories of the sealing of the two-party partner difference (2) (Mathews, 1992):

- 1- D > 0 If it is (Hyperbolic) a differential equation of the type of olive.
- 2- D = 0 If it is (parabolic) a differential equation of equivalent type.
- 3- D < 0 If Elliptic is a differential equation of the type of counterpart.

Definition: The issue of a special solution to the differential equation that certain primary conditions, called the Qushi issue. Differential equations are one of the most important math branches in their applications, and the differential equation of the difference, a particular function must be found, so that we can put a law whose description is given as a certain phenomenon or a process (Farlow, 1993).

Definition: Solution Question of Queshi Type: (F, X, Y) is a solution to the equation given to the Y-Ox form, XP. Choose a solution from an infinite group requires the prelimination of preliminary conditions and borders. In this work B and the limits of R Robent, we are taking a continuous and closed area, therefore, a solution to the differential equation must be found if the primary and border conditions are given.(Othman & Mahjob, 2016).

Differential terms of gender:

When studying the rapid operations of different physical nature (The vibrations, heat transfer, spread) usually comes from the equality of the core type. To take the equation of Labul: $\Delta u = 0$

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



The Tastem function is called in the region if it is continuing in this area with its derivatives until the second rank and achieves the equation of Labuls (Essa, 2019).

The method of differences specified to round derivatives:

the idea of the specific difference method, or network method is: in the R / Diamond area (the 98bit) area is created, which is limited to BM borders to round the b limit (B) RE (Figure 2) (Press et al., 1986).



2. The differential equation is known to be the field of network replacing the equation of differences (to rubble with the specific derived.

3. The internal scale and the border of the GH areas and board bands are connected BH by the system of linear or non-linear equations system $(x, y) \rightarrow u(x_i, y_j)$. So the continuous solution is made through a selection of separate values from the network field. To take the network on the surface (X, Y) and the following field of the network:

$$x_i = x_0 + ih,$$

 $y_j = y_0 + jk ,$

Where: $0 \le i \le N$, $0 \le j \le M$

To round the first derived and second for the *X* variable we use the Ticker microwave for Magitarin and Callati (Morton & Mayers, 2005):

$$u(x_{i\pm 1}, y_j) = u(x_i \pm h, y_j) = u(x_i, y_j) \pm h \frac{\partial u}{\partial x} (x_i, y_j) + \frac{h^2}{2} \frac{\partial u}{\partial x^2} (x_i, y_j) \pm \frac{h^3}{6} \frac{\partial^3 u}{\partial x^3} (x_i, y_j) + \frac{h^4}{24} \frac{\partial^4 u}{\partial x^4} (\bar{x}_i, y_j)$$



R and region B form-2-network network border $\bar{x} \in x_i + \theta h, 0 < \theta < 1$ Take the first two and seconds of the series above and then find the solution for the first duration of the variable *X*

$$\frac{\partial u}{\partial x}(x_i, y_j) = \frac{u(x_{i+1}, y_j) - u(x_i, y_j)}{h} + O(h) = \frac{u(x_i, y_j) - u(x_{i-1}, y_j)}{h} + O(h) \approx \frac{u(x_{i+1}, y_j) - u(x_{i-1}, y_j)}{2h} + O(h^2)$$

We use the same way to find the second derivative with note that it will appear first and derived up in the first derived from the first derived from the differences to get:

$$\frac{\partial^2 u}{\partial x^2} (x_i, y_j) = \frac{u(x_{i+1}, y_j) - 2u(x_i, y_j) + u(x_{i-1}, y_j)}{h^2} + O(h^2)$$

 $\frac{\partial u}{\partial y}, \frac{\partial^2 u}{\partial y^2}$ variable y

In the same way, we can find the first and secondary

$$\frac{\partial u}{\partial y}, \frac{\partial^2 u}{\partial y^2}$$
 variable y

In the practical side, many templates are used to build schemes for correspondence. To now write bulk bulk to the elements of the neon:

For the Lasel to the Florip, the formula will be similar, but h = k and the following:

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



$$\frac{u_{i+1,j} - 2u_{i,j} + u_{i-1,j}}{h^2} + \frac{u_{i,j+1} - 2u_{i,j} + u_{i,j-1}}{h^2} = 0$$
$$\frac{u_{i+1,j} - 4u_{i,j} + u_{i-1,j} + u_{i,j+1} + u_{i,j-1}}{h^2} = 0$$

It can be noted that the function (x_i, y_j) is the solution to the Labulas in the node (I, J), average the neighboring contract and the differences are selected in the following plans (Lippold, 1980):



Form (4) scheduled selection charts.

For the Laselax to the Royal Region of the Group and the above scheme will be by the following equation (Smith et al., 1985):

$$u_{i,j} = \frac{1}{4} \left[u_{i+1,j+1} + u_{i+1,j-1} + u_{i-1,j-1} + u_{i-1,j+1} \right] \dots (7)$$

To take a problem to Drilcell's problem to the Lailpace:

Continuous function $\varphi(P)$ so that in the case of the source network, the two decades are called one distance on the contractor, the contract of the inner part of the internal contract is called. The contract that has a least one internal negotiator is called the border contract of the first type. The equation solution (8) through the way of the differences limited, according to equation (6), Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 **Publication Date: 5-1-2022** ISSN: 2706-6495



We get the assembly system for each internal node of the contract distribution area $(x_i, y_i) \in Sh$ of the border condition in (8) We find: $u(A) = \varphi(A)$ (9) Where the A venue of the border B.

Solve the equivalent partial equivalent equity using network method: To take the issue of heat: to find the function u(x, t) that is equal: (Morton & Mayers, 2005)

$$\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$$
primary conditions:

With

primary

U(x,0) = f(x), (0 < x < s)

For border terms : $u(0,t) = \varphi(t), u(s,t) = \psi(t)(t > 0)$ To find the approximate solution for the previous issue by the network method, take a rectangular network of the contract in the tape $0 \le x \le s$, $t \ge 0$ The intersection points are two groups of parallel lines: x = ih, (i = ih)0,1,...), t = jk, (j = 0,1,...)

Now to put: xi = ih, $t_i = jk$, $u_{ij} = u(x_i, t_j)$,

Now to find approximate replacement at each internal node (x_i, t_j) for second subscription $\frac{\partial^2 u}{\partial x^2}$ 22. 11 241 1

$$\frac{\partial^2 u}{\partial x^2} \approx \frac{u_{i+1,j} - 2u_{i,j} + u_{i-1,j}}{h^2}$$

Approximate replacement at each internal node (x_i, t_j) for the first subscription:

$$\frac{\partial \mathbf{u}}{\partial \mathbf{t}} \approx \frac{u_{i,j+1} - u_{i,j}}{k}$$

To compensate for these arrests in heat equation, we find:

$$\frac{u_{i,j+1} - u_{i,j}}{k} = a^2 \frac{u_{i+1,j} - 2u_{i,j} + u_{i-1,j}}{h^2}$$

The first difference chart is clear, the second is implicit. So we will get the valuable values that include values of the solution in four holding and accuracy of the accuracy of (k + h) to put $\rho =$ $\frac{a^2k}{k^2}$, turn the final equation to the following form:

$$u_{i,j} + 1 = 1 - 2\rho u_{ij} + \rho u_i + (1,j) + u_i - (1,j)$$

At choice number (p) in equal above (Essa, 2019):

- The precision in the replacement of the differential equation must be the most important of the differences.
- The stable difference must be stable
- that the previous formula is stable if it is $0 < \rho \le \frac{1}{2}$

As a simplified form of previous equation $\rho = \frac{1}{2}$

$$u_{i,j+1} = \frac{u_{i+1,j} + u_{i-1,j}}{2}$$
(10)
When $\rho = \frac{1}{6}$

$$u_{i,j+1} = \frac{1}{6}u_{i-1,j} + 4u_{i,j} + u_{i+1,j}$$

Example:

Using the equation of the differences (10) Trust the round of the equation equivalent: $ut = 8u_{xx}$ $u(x, 0) = 13 \sin \frac{\pi}{2} x$, $0 \le x \le 2$

And

 $u(0,t) = u(0,t) = 0, 0 \le t$

The percentage of the changer X is selected (h = 0.25) and using the equation of the difference

(10) that is (P = 1/2) for the variable (t), we find that $k = \frac{ph^2}{a^2}$: $U_{i,j+1} = \frac{u_{i,j+1}+u_{i,j-1}}{2}$ this is the leads $U_{i,1} = \frac{u_{i+1,0}+u_{i-1,0}}{2}$ $U_{1,1} = \frac{u_{2,0}+u_{0,0}}{2} = \frac{1}{2}(9.1924+0) = 4.5962$

$$U_{2,1} = \frac{u_{3,0} + u_{1,0}}{2} = \frac{1}{2}(12.0104 + 4.9749) = 8.4927$$

So be table values function at some

$$i = 1,2,3,4,5,6,7,8\& j = 1,2,3,4,5,6,7,8$$

Analytical analysis of the equal state equal to the comparison:



Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



$$\tilde{u}(x,t) = \sum_{n=1}^{\infty} e^{-2\pi^2 n t} B_n \sin \frac{\pi n}{2} x,$$

As

$$B_n = \frac{2}{2} \int_0^2 13 \sin \frac{\pi}{2} x \sin \frac{\pi n}{2} x dx \neq 0$$

At n = 1

$$B_1 = 13 \int_0^2 \sin^2 \frac{\pi}{2} x dx = \frac{13}{2} \int_0^2 (1 - \cos \pi x) dx = \frac{13}{2} [x - \frac{1}{\pi} \sin \pi x] = 13$$

And this is finding : $\tilde{u}(x,t) = 13e^{-2\pi^2 t} \sin \frac{\pi}{2} x$ (Smith et al., 1985).

In the last two lines of the table below the valid solution values are given to the issue and precision factor $|\tilde{u} - u| at$ t = 0.0312 Here can find the rest of the values by the following table (Lippold, 1980):

| l | i | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----|-------------------|-----|--------|--------|---------|---------|---------|--------|--------|-----|
| j | 1, 1, | 0,0 | 0,25 | 0,5 | 0,75 | 1,0 | 1,25 | 1,5 | 1,75 | 2,0 |
| 0 | 0,0 | 0 | 4,9749 | 9,1924 | 12,0104 | 13,0 | 12,0104 | 9,1924 | 4,9749 | 0 |
| 1 | 0,0039 | 0 | 4,5962 | 8,4927 | 11,0962 | 12,0104 | 11,0962 | 8,4927 | 4,5962 | 0 |
| 2 | 0,0078 | 0 | 4,2464 | 7.8462 | 10,2516 | 11,0962 | 10,2516 | 7,8462 | 4,2464 | 0 |
| 3 | 0,0117 | 0 | 3,9231 | 7,2490 | 9,4712 | 10,2516 | 9.4712 | 7,2490 | 3,9231 | 0 |
| 4 | 0,0156 | 0 | 3,6245 | 6.6972 | 8,7503 | 9,4712 | 8,7503 | 6,6972 | 3,6245 | 0 |
| 5 | 0,0195 | 0 | 3,3486 | 6,1874 | 8,0842 | 8,7503 | 8,0842 | 6,1874 | 3,3486 | 0 |
| 6 | 0,0234 | 0 | 3,0937 | 5,7164 | 7,4689 | 8,0842 | 7,4689 | 5,7164 | 3,0937 | 0 |
| 7 | 0,0273 | 0 | 2,8582 | 5,2813 | 6,9003 | 7,4689 | 6,9003 | 5,2813 | 2,8582 | 0 |
| 8 | 0,0312 | 0 | 2,6407 | 4,8793 | 6,3751 | 6,9003 | 6,3751 | 4,8793 | 2,6407 | 0 |
| ũ(| (x;0,0312) | 0 | 2,6873 | 4,9655 | 6,4877 | 7,0223 | 6,4877 | 4,9655 | 2,6873 | 0 |
| | $ \tilde{u} - u $ | 0 | 0,0466 | 0,0862 | 0,1126 | 0,1220 | 0,1126 | 0,0862 | 0,0466 | 0 |

The method of advantages of Koshi:

This method is used to resolve non-linear differential equations on the following image (Farlow, 1993):

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33 Publication Date: 5-1-2022 ISSN: 2706-6495



Which can be written on the picture:

 $f(x, y, z, p, q) = 0; p = \frac{\partial z}{\partial x}$, $q = \frac{\partial z}{\partial y}$ (2)

No one of the five-year-old category {y(t), x(t), p(t), q(t), z(q)} Check the equation: C on the curve (x, y, z) The sector is at point

z'(t) = p(t)x'(t) + q(t)y'(t), x = x(t), y = y(t), z = z(t) for each values T on a convenient and contestant and if (I) at the bottom of the curve C. The prime The sector is a distinctive sector and the diverse equations of the sector are as derived as follows:

Total inspec to z (Hockney & Eastwood, 2021):

$$dz = \frac{\partial z}{\partial x}dx + \frac{\partial z}{\partial y}dy$$

Or $dz = pdx + qdy$ (3)
Where p, q check the equation
By ending the equation (3) for P:

 $dx + \frac{dq}{dp} dy = 0 \implies \frac{dq}{dp} = -\frac{dx}{dy}$ (4)

By ending the equation (2) for P:

$$f_p + \frac{\partial f}{\partial q} \frac{dq}{dp} = 0 \implies \frac{dq}{dp} = -\frac{f_p}{f_q}$$
(5)

This is included:

And compensation for dx in the equation (3):

$$dz = p \frac{f_p}{f_q} dy + q dy \qquad \Longrightarrow \quad dz = \left(\frac{p f_p + p f_q}{f_q}\right) dy$$

Any:
$$\frac{dz}{pf_p + qf_q} = \frac{dy}{f_q}$$
(7)



Of the two equation (6), (7) we find that:

So on the eligibility of the distinctive sector of the $\dot{x}(t)$, $\dot{y}(t)$, $\dot{z}(t)$ should be proportional to f_p , f_a , $pf_p + qf_a$ respectively, and if we choose the medium (*t*) on the following image (Mathews, 1992):

$$\dot{x}(t) = f_p \quad \dot{y}(t) = f_a$$
(9)

Mortal:

On the ability to distinguish the sector is a job in T and so on:

$$\dot{p}(t) = \frac{\partial p}{\partial x}\frac{dx}{dt} + \frac{\partial p}{\partial y}\frac{dy}{dt}$$

Of the two equations in (9) we find that:

$$\dot{p}(t) = \frac{\partial p}{\partial x} f_p + \frac{\partial p}{\partial y} f_q$$

But:

$$\frac{\partial p}{\partial y} = \frac{\partial}{\partial y} \left(\frac{\partial z}{\partial x} \right) = \frac{\partial}{\partial x} \left(\frac{\partial z}{\partial y} \right) = \frac{\partial}{\partial x} (q)$$

Wherefore:

By the end of the equation (2) for *X*:

$$f_{x} + pf_{z} + f_{p}\frac{\partial p}{\partial x} + f_{q}\frac{\partial q}{\partial x} = 0$$

Or $f_{p}\frac{\partial p}{\partial x} + f_{q}\frac{\partial q}{\partial x} = -(f_{x} + pf_{z})$ (12)

Of the two equations in (11), (12) we find that:

$$p'(t) = -(f_x + pf_z)$$
(13)



As we find that:

$$\dot{q}(t) = \frac{\partial q}{\partial x}\frac{dx}{dt} + \frac{\partial q}{\partial y}\frac{dy}{dt}$$

Of the two equations in (9) we find that:

$$\dot{q}(t) = \frac{\partial p}{\partial x} f_p + \frac{\partial q}{\partial y} f_q$$

But: $\frac{\partial q}{\partial x} = \frac{\partial}{\partial x} \left(\frac{\partial z}{\partial y} \right) = \frac{\partial}{\partial y} \left(\frac{\partial z}{\partial x} \right) = \frac{\partial}{\partial y} (p)$

Where for $\dot{q}(t) = \frac{\partial p}{\partial y} f_p + \frac{\partial q}{\partial y} f_q$ (14)

By the end of the equation (2) for y:

$$f_{y} + qf_{z} + f_{p} \frac{\partial p}{\partial y} + f_{q} \frac{\partial q}{\partial y} = 0$$

Or:
$$f_{p} \frac{\partial p}{\partial y} + f_{q} \frac{\partial q}{\partial y} = -(f_{y} + qf_{z}) \qquad (15)$$

Of the two equations in (14),(15) we find that:

 $q(t) = -(f_y + qf_z)$ (16)

Thus we get the regular differential equivalent system that determines the distribution sector of the equation (2) (Lippold, 1980):

$$\begin{split} \dot{x}(t) &= f_p , \dot{y}(t) = f_q , \dot{z}(t) = pf_p + qf_a \\ \dot{p}(t) &= -(f_x + pfz_z) , \dot{q}(t) = -(f_y + qf_z) \end{split}$$

Conclusion

The conclusion has sought to find out the partial and normative differential equations through the validity of the regular and visual differential equivalent equity and to build the context of the equivalence of the use of numerical and analytical methods, and the search for the use of these equations on the Sports and Physical Side and the importance of those equations, but the focus mainly on the construction of these equations and methods of solve.





References:

Essa, Najiah. (2019). Analytical ways to resolve unrealistically differential equations from the first level, the third annual conference on theories and core and vital sciences.https://www.misuratau.edu.ly/journal/sci/upload/file/R-901-Conf 3 pages%20285-298.pdf

Farlow, S. J. (1993). *Partial differential equations for scientists and engineers*. Courier Corporation.

- Hockney, R. W., & Eastwood, J. W. (2021). Computer simulation using particles. crc Press.
- Lippold, G. (1980). Mitchell, AR/Griffiths, DF, The Finite Difference Method in Partial Differential Equations. Chichester-New York-Brisbane-Toronto, John Wiley & Sons 1980 XII, 272 S., £ 8.95. ISBN 0-471-27641-3.

Mathews, J. H. (1992). Matlab Programming Guidebook for Numerical Methods.

- Morton, K. W., & Mayers, D. F. (2005). *Numerical solution of partial differential equations: an introduction*. Cambridge university press.
- Othman, A., & Mahjob, E. (2016). *Numerical Solutions of Non-linear Equations With Algorithm Programs*(Doctoral dissertation).
 <u>http://dglib.nilevalley.edu.sd:8080/xmlui/handle/123456789/915</u>.
- Press, W. H., Flannery, B. P., Teukolsky, S. A., & Vetterling, W. T. (1986). Numerical Recipices, the Art of Scientific Computing. *Cambridge U. Press, Cambridge, MA*.
- Smith, G. D., Smith, G. D., & Smith, G. D. S. (1985). *Numerical solution of partial differential equations: finite difference methods*. Oxford university press.

Copyright © 2022 Turkia Dhawi Alqurashi, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC) Doi: https://doi.org/10.52132/Ajrsp.e.2022.33.5



Expression of Heat Shock Protein HSP90 in Genomic-DNA of Chickpea (Cicer arietinum L.) Callus by Heat Shock Treatment

Anwaar F AL-Taee*

Ph.D. Student, Department of Biology, Education College for Pure Sciences, University of Mosul,

Iraq

E-mail: anwar.altaee@uomosul.edu.iq

Dr. Jamella H Rasheed

Prof. Doctor in Biology, Department of Biology, Education College for Pure Sciences,

University of Mosul, Iraq

Email: dr.jamella.h.rasheed@uomosul.edu.iq

Abstract:

This study was able to detect of the expression activity of heat shock proteins *HSP90* and heat transcription factors HSFs for the first time in callus cultures of chickpea, *Cicer arietinum* L., that exposed to abiotic shocks, grown on MS medium supplemented with 1.0 mg L⁻¹ naphthalene acetic acid (NAA) and 2.0 mg L⁻¹ benzyl adenine (BA). Heat shock proteins HSPs were constructed for increase of withstand long-term physical shocks, and production of resistant to heat chickpeas plants, this shock was enhancement of tolerance of chickpea callus to abiotic stresses (high - temperatures). Results enhanced the ability of chickpea callus to abiotic stresses bearing and induce of HSF genes to heat shock proteins *HSP90* production quickly to removing denatured proteins, avoid apoptosis, thus, supporting tolerance to the sudden action of these shocks. Expression activity of heat shock genes and transcription factors by determined based on polymerase chain reaction qPCR, that explained the gene activity increasing at shocks intensity increased,



And exposure period simultaneously with the increase in the recorded RNA and DNA concentrations. Expression of heat shock genes and transcription factors in the current study was determined by adopting the qPCR, results of which demonstrated an increase in gene activity with at the heat shock intensity increase, with increases of DNA, RNA concentrations. Nitrogenous bases sequences of thirty samples of callus of embryos, hypocotyl which exposed to heat shocks, and the comparison callus were determined by the specific polymerase chain reaction sPCR for detection of *HSP90* genes. The purified DNA of chickpea plant was match with genes in the NCBI Genetic Data Bank, with many mutations whose effects varied in the amino acids type, thus, contributed to the identification of heat shock proteins. Phylogenetic tree data confirmed the existence of a close relationship between the chickpea cultivar under study and the Indian and Egyptian cultivars registered in NCBI by adopting molecular evidence represented by the genes of heat shock proteins.

Keywords: Chickpea (*Cicer arietinum* L.), Heat stress, Heat shock protein *HSP*90, RNA sequencing, gene Expression

1. Introduction

Chickpea (*Cicer arietinum* L.) is considered one of the most important types of food legumes in the world in economic terms, and cultivated at a rate of 14.56 million/hectares with a productivity of 11.68 million tons in more than 55 countries (1). The legume family (Fabaceae) constitutes the third largest family with more comprises than 650 genera and 18000 species, the genus Cicer includes 43 cultivated species (2). The annual chickpea plant is self-pollinating 2n=16 (3).

Modern biological technologies have contributed to improving the production of leguminous crops and developing high-quality crop varieties. Legumes are among the crops sensitive to biotic and abiotic stresses (4). Plants deal with environmental stresses and cause a significant loss in production, because they pose a serious threat to plant survival. Despite this, plants have evolved a diverse set of adaptation mechanisms to resist environmental conditions through increased expression of heat shock genes (5). These genes activate metabolic pathways in plants to withstand the harmful effects of various stresses including temperature, drought, salinity, photooxidation,



Heavy metals, high intensity radiation, wounds and other environmental factors (6). Most of the genes responsive to heat stress (HS) are involved in primary and secondary metabolic processes, translation, transcription, regulation and response to biological processes in plants such as calcium transport, phytohormones, sugars and lipids or protein synthesis including phosphorylation (7).

Heat shock proteins (HSPs) are considered essential in acquisition of heat tolerance in plants (8). The sources mentioned the positive effects of heat shock in a number of leguminous plant systems and its stimulation of metabolic pathways in cells represented in building new proteins, as in chickpea and soybean plants (9). Heat shock proteins (HSPs) function as molecular chaperones, successfully involved in the quality and type control of protein within living cells to maintain cellular homeostasis under environmental stress conditions (10). Heat shock of plant cells contributed to improving the plant species through changes in the fluidity of cell membranes and the accompanying changes at the molecular level. The expression of genes related to the regulation of the transcription process and synthesis of various proteins (11). Therefore, some plants respond to such stresses by reprogramming their proteins to ensure a steady state of metabolic processes that help them to survive and function under stress conditions (12). The genetic basis of chickpea is expected to be an important factor in stress tolerance by restoring cellular homeostasis and its direct effect on cellular and physiological changes (13).

Among the families of stress-responsive genes, there are HSP90. genes Known to be involved in both biotic and abiotic stresses and heat shock protein (*HSP90*) The family is important, because it not only regulates responses against various biotic and abiotic stresses in plants, but also play an important role in various developmental processes (14). Expression *HSP90* against high temperatures is one of its best properties' responses. *HSP90* escorts are basically, and expressed in most organisms under normal conditions, while, expression increases significantly under stress. *HSP90s* play a vital role in plant development, stress response and disease resistance (15). Recent studies have indicated that heat shock protein *HSP90* is one of the most abundant proteins in living cells when exposed to abiotic stresses (16). This manuscript aimed to study the role of heat shock in chickpea callus growth, characteristics, and to identify heat shock genes *HSP90* in exposed tissues to these shocks.



2. Materials and Methods

Embryos and Hypocotyl Production

Cicer arietinum L. "Desi variety" seeds were sterilized by immersing in 96% ethyl alcohol for 2 min., submerging in sodium hypochlorate solution (NaOCl 5%) for 5 min., then washed four times with sterile distilled water. Sterilized seeds were transferred to the surface of 25 ml of solid basal MS medium free from growth regulators (17). in 100 ml glass containers and incubated in culture room 23°C, light intensity of 2000 lux at 8/16 light / hour. Sterile seeds and seedlings were used as source of embryos and hypocotyls, respectively.

Callus Initiation

Sterilized seedlings 12-15 days old were excised, and divided into small pieces of 1.5 cm length. Embryos and hypocotyls fragment of each seedling were cultured on agar solidified MS medium containing 3% sucrose, provided with 1.0 mg L⁻¹ NAA and 2.0 mgl-1 BA (20) for callus initiation. The end cation was MS+NAA+BA cultures were kept at culture room conditions.

Embryos and hypocotyls callus exposed to heat treatment

A set of 30-day-old callus samples weighing 1 g were taken from hypocotyls and embryos and placed in sterile glass containers of 100 ml and exposed to each temperature of 30, 35, 40, 45 and 50 ° C. Exposure time 5, 10 min. named short-term heat shock, and in the other treatment it appeared at the same temperature but for 15, 20 min., that called long term heat shock (18). Use a hot waterbath in the required degrees for both treatments. After exposure, all samples are placed directly in a baker of room temperature water to reduce their temperature. After exposing all samples were cultivated in MS medium mentioned previously.

Assay *HSP90* genes expression in exposed callus to heat shock

The reverse transcription PCR was used to identify the cDNA strand by adopting mRNA as the genetic material isolated from callus to be the cDNA reverse amplification product. The basis for a second step was the quantitative amplification of the reverse amplification product by quantitative real time (qPCR) technique to assess the number of mRNA copies produced by expression of the target gene (Table 1).



| Gene | Sequence 5'-3' | initiator | size (bp.) |
|-------|----------------------|-----------|---------------|
| HSP90 | GCCTCCGTGCTTTGGTAA | Forward | 356 base pair |
| | TGCCAAGAACCTCACCAGTA | Reverse | |

Table 1: Sequence of primer set used in the study.

RNA isolation and RNA-seq

The extracted RNA was reverse transcribed to cDNA using Prime Script 1st strand cDNA synthesis kit Miniprep RNA extract kit (S. Korea) Gene all. The cDNA was performed on Rotorgene Q real-time PCR system with SYBR Green PCR Kit (Wiz bioScript-TM cDNA synthesis Kit) and transcript specific primers. The cDNAs have been checked expression of heat stress marker (GMHsp90C2.1). This can validate for the plants applied heat stress (19). PCR primers were designed with the parameters of 17-25 nucleotide lengths, and 150-200 product size. PCR program was set as 5 minutes at 95°C, 40 cycles each of 20 seconds at 95°C, 30 seconds at 59°C. Melt curve analysis was performed at the end of every PCRs. Threshold cycle for each reaction was normalized with expression value of Act B (B-actin). Relative expression values were calculated by 2–CT method (19). All experiments were processed with three biological replicates to obtained high credibility of experiments.

Genetic determinants amplification and sequencing alignment

sPCR Master Mix was 10μl (Gene All, S.Korea), additional components were1μl (10μM) of each of forward and reverse primer set (Ella Biotech ,Germany), 4μl of gDNA (10ng\ml), the final volume was completed to 20μl with nuclease free water (4μl). The ITS1, ITS4 primer set that used in this research was listed in table one. Amplification steps were initial denaturation 95°C for 4min, then 35 cycles of each denaturation at 95°C for 30 sec., annealing temperature 60°C for 30 sec. to hybrid the primers, extension at 72°C for 30 sec., and final extension at 72°C for 5 min. Amplification products were purified using PCR purification Kit (Gene All, S.Korea),which was sequenced using genetic lyzer (Applied Bio-systems3500. USA). The sequence was aligned (Mega X-software) and assembled via National Center for Biotechnology Information (NCBI), using the Basic Local Alignment Search Tool (BLAST).



Phylogenetic Analysis

Protein sequences of chickpea *HSP90* were aligned using phylogenetic tree was generated based on the MEGA software version 6.0. (Phoenix, AZ, USA) (20). and protein formation of *Cicer arietinum* heat shock 90 kDa protein gene using Expasy software (21).

3. Result

Detection of heat shock protein *HSP*90 gene expression activity in embryogenic and hypocotyls callus exposed to heat shock.

Gene expression of *HSP*90 (heat shock protein) samples were determined by RT-PCR techniques. These techniques revealed the activity of the *HSP*90 genes of the standard gene Beta Actin in the early stages of the amplification processes during the reaction (Fig.1).



Fig.1: Expression of the β Actin gene standard for heat shock proteins *HSP90* of chickpea *Cicer arietinum* L.

Each of embryonic and hypocotyls callus exposed to heat shock and control samples was determined by adopting the reading of a Nano Spectrometer (nano, 2000, Thailand) at wavelength of 260 / 280 nm. Nuclear RNA in the callus exposed to heat shock 45 $^{\circ}$ C / 15 and 20 min., additionally to non-exposed callus (Table 2).

| Table 2: | Concentration | n and p | ourity | of RNA | isolated | from | tissues | of e | embryonic | callus | and |
|----------|-------------------|---------|---------|----------|----------|--------|----------|------|-------------|--------|-----|
| hypocot | yls callus of chi | ckpea (| Cicer a | rietinum | L. expos | sed an | d not ex | xpo | sed to heat | shock. | |

| | Embryonic c | Hypocotyls calli | | |
|---------|-------------|------------------|-----------|---------------|
| Samples | Purity | RNA (ng/µ) | Purity | RNA (ng/µ) |
| °C/min | 280 / 260 | Hypocotyls | 280 / 260 | Embryo callus |

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33



Publication Date: 5-1-2022

ISSN: 2706-6495

| control | 1.9 | 6012 | 1.9 | 8149 |
|---------|-----|-------|-----|-------|
| 30 | 1.7 | 6582 | 1.7 | 6635 |
| 35 | 1.9 | 7313 | 2 | 7283 |
| 40 | 1.8 | 9377 | 1.8 | 12462 |
| 45 | 1.7 | 9628 | 1.9 | 16539 |
| 50 | 1.8 | 11901 | 1.8 | 6175 |

Detection of *HSP*90 gene expression activity in embryonic and hypocotyls callus exposed to heat shock.

Samples of RNA samples extracted from the genetic repertoire were amplified for the purpose of stabilizing the genetic expression of HSP90 genes in RNA samples extracted from embryonic callus and hypocotyls callus under study. High temperatures degree stimulated the activity of HSP90 gene expression and the melting curve of HSP90 heat shock protein genes, which shows the absence of dimer in the callus samples under study (Fig.2).



Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33Publication Date: 5-1-2022ISSN: 2706-6495





Fig. 2: Melting curve and genetic expression of heat shock protein *HSP90* genes of embryonic and hypocotyls calli of *Cicer arietinum* L. exposed to heat shock.

The achieved results (Table 3) demonstrated a high increase in the activity of the *HSP90* gene responsible for shock proteins in terms of increase in expression levels of the Δ ct gene when callus exposed to heat shock with a selected duration 5-20 min. For the shock of the embryonic callus exposed to 45 °C and 50 °C, compared to samples exposed to low temperatures and after thirty days of exposure to both STHS and LTHS which recorded a slight increase in activity of *HSP90* gene. Long-term heat shock achieved an increase in the amount of RNA, as it was noted that its purity was suitable for performing simultaneous sequence replication qPCR.

Table 3: HSP90 gene expression activity of embryonic callus of chickpea Cicer arietinum L.exposed to heat shock

| Embryonic callus C / min° | Beta actin | HSP90 | Δct |
|------------------------------|------------|----------|------------------|
| control | 18.83878 | 23.09563 | 0 |
| 30 / 10 | 19.12056 | 20.55118 | - 2.826241493 |
| 35 / 5 | 19.41429 | 10.53783 | - 13.13332415 |
| 40 / 20 | 19.31317 | 9.936205 | -13.6338253 |
| 45 / 15 | 18.9709 | 9.407584 | - 13.82017231 |
| 50 / 15 | 19.29653 | 7.027575 | - 13.82017231 |

Whereas, data of qPCR products indicated that heat shock supported high levels of Δ ct and stimulated the *HSP90* gene for hypocotyls callus.



It was noted that the activity of the gene stimulating heat shock proteins increase at its highest levels, and the amount of RNA increased with highe temperatures and exposure time compared to the rest of treatments and controls (Fig.3).





Data of qPCR products (Table 4) indicated that heat shock supported high levels of Δ ct and stimulated *HSP*90 gene of hypocotyls callus (Fig.4). It was noted that the activity of the gene stimulating heat shock proteins increased at its highest levels, and the amount of RNA increased with higher temperatures and exposure time compared to the remaining of the treatments and comparisons.





Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33



Publication Date: 5-1-2022

ISSN: 2706-6495

| hypocotyls callus C / min° | Beta actin | HSP90 | ∆ct |
|-------------------------------|------------|----------|--------------|
| control | 18.83878 | 23.09563 | 0 |
| 30/20 | 19.03487 | 20.77749 | -2.514243126 |
| 35/10 | 18.83764 | 10.31478 | -12.77971601 |
| 40/15 | 19.05466 | 9.907241 | -13.40427113 |
| 45/20 | 19.32304 | 9.605064 | -13.97482967 |
| 50/5 | 19.12325 | 7.149771 | -16.23033714 |

Table 4: HSP90 gene expression activity of the hypocotyl callus of chickpea Cicer arietinum L.subjected to heat shock.

Molecular investigation of the genes of heat shock proteins *HSP*90 in embryogenic and hypocotyls calli of chickpea *Cicer arietinum* L.

Isolation of genomic DNA

The concentration of deoxygenated DNA extracted from samples of embryogenic and hypocotyls calli subjected to physical shock and control samples were determined by adopting the reading of a nano spectrophotometer (Nano 2000, Thailand) at wavelength of 260/280 nm and DNA concentration in callus was superior. subjected to heat shock $40^{\circ}C / 20$ min.

Nitrogenous base sequences for PCR products

Sequencing technology aimed to determine the relative positions of nitrogenous bases of DNA pieces obtained from the specialized replication reaction of DNA samples extracted from callus samples demonstrate to confirm the diagnosis of chickpea callus by adopting sequence alignment of the nitrogenous bases of the HSP90 genes.

Molecular expiantion of the HSP90 gene.

The results of PCR indicate performed for DNA samples isolated the extracted DNA products were obtained from samples of one size (356) base pair (Fig.5) and it has the ability to encode 237 amino acids in chickpea plant.



M = 1 = 2 = 3 = 4 = 5 = 6 = 7 = 8 = 9 500 bp = 356 bp = 1 = 1 = 1 = 1 = 1 = 1

Fig. 5: Bundle of DNA bands of Cicer arietinum L. amplified for the HSP90 gene.

- Lane (M) represents the molecular scale
- Lane (1) represents the control
- Lane (2 9) represents a positive result for the presence of the bands representing the gene *HSP*90 (356) base pair of the embryo and hypocotyls callus of chickpea.

The results showed the alignment of the nitrogenous bases of 356 nitrogenous bases of chickpea calli samples with their complementary nitrogenous bases of *HSP*90 gene, as follows:

The sequences of embryogenic callus samples subjected to heat shock were entered into the NCBI-BLAST program available at <u>https://blast.ncbi.nlm.nih.gov/Blast.cgi</u> and the MEGA6.0+ BLAST program to analyze these sequences and show their affinity with the existing sequences. Results of analysis showed a significant similarity of -99% between these sequences and the sequences recorded in the Gene Bank with the number XM_004491473.2. (Table 5) shows a comparison of the DNA sequences of the samples of the embryonic callus, as it was noted that there are areas of replacement there were mutations of the type of transition at the site (573) that did not affect the genetic code and then the type of amino acid that constitutes the shock protein *HSP90*.

 Table 5: Analysis of the DNA sequences of HSP90 genes from chickpea Cicer arietinum L.

 embryonic callus exposed to heat shock.

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33



Publication Date: 5-1-2022

ISSN: 2706-6495

| Source: Cicer arietinum heat shock 90 kDa protein | | | | | | | | |
|---|-----------------------------|--------------|----------------|--------------------------|---|-------------------------|--------------------------------------|----------------|
| Sampl e °C / min | Type of substitut ion | Locati on | Nucleot ide | Nucleot ide change | Amin o acid chang e | Predict ed effect | Sequence ID with compare | Identiti es |
| Contr ol | Transitio n | 573 | G\A | GAG\G AA | Gluta mic acid\ Gluta mic acid | Silent | ID: <u>XM_004491</u> <u>473.2</u> | 99% |
| / 10 30 | Transitio n | 573 | G\A | GAG\G AA | Gluta mic acid\ Gluta mic acid | Silent | ID: <u>XM_004491</u> <u>473.2</u> | 99% |
| 35 / 5 | Transitio n | 573 | G\A | GAG\G AA | Gluta mic acid\ Gluta mic acid | Silent | ID: <u>XM_004491</u> <u>473.2</u> | 99% |
| / 20 40 | Transitio n | 402 | G\A | TTG\TT A | Leucin e\ Leucin e | Silent | ID: <u>XM_004491</u> <u>473.2</u> | 99% |
| / 15 45 | Transitio n | 573 | G\A | GAG\G AA | Gluta mic acid∖ Gluta mic acid | Silent | | |
| / 15 50 | Transitio n | 573 | G\A | GAG\G AA | Gluta mic acid\ Gluta mic acid | Silent | ID: <u>XM_004491</u> <u>473.2</u> | 99% |



Analysis results (Table 6) of nitrogenous bases sequences of the heat shocked hypocotyls callus samples subjected to heat shock and their convergence with the existing sequences recorded in the gene bank. The areas of substitution between the nitrogenous bases were observed between callus sample subjected to heat shock 35° C/10 min and registered in NCBI. It was a substitution site 398 and the mutation affected the genetic codes and then the encoded amino acids, as amino acid threonine was replaced by lysine. While the mutations in the callus samples exposed to heat shock did not affect the type of amino acids encoded.

Table 6: Analysis of the DNA sequences of HSP90 genes from chickpea Cicer arietinum L.hypocotyls callus exposed to heat shock.

| | Source: Cicer arietinum heat shock 90 kDa protein | | | | | | | |
|----------------------------|---|--------------|----------------|-----------------------|---------------------------------------|----------------------|--------------------------------------|----------------|
| Sampl e C / ° min | Type of substitutio n | Locatio n | Nucleoti de | Nucleotid e change | Amino acid change | Predicte d effect | Sequence ID with compare | Identiti es |
| Contro 1 | Transition | 573 | G\A | GAG\GA A | Glutamic acid∖ Glutamic acid | Silent | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |
| 30/20 | Transition | 573 | G\A | GAG\GA A | Glutamic acid\ Glutamic acid | Silent | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |
| 35/10 | Transverti on | 398 | C∖A | ACA\AA A | Threonin e\ Lysine | Missens e | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |
| 40/10 | Transition | 573 | G\A | GAG\GA A | Glutamic acid\ Glutamic acid | Silent | | |
| 40/15 | Transition | 573 | G\A | GAG\GA A | Glutamic acid∖ Glutamic acid | Silent | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |
| 45/20 | Transition | 573 | G\A | GAG\GA A | Glutamic acid∖ Glutamic acid | Silent | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |

Academic Journal of Research and Scientific Publishing | Vol 3 | Issue 33



Publication Date: 5-1-2022

ISSN: 2706-6495

| 50/5Transition573 $G A$ $G AG GA A$ AA | Glutamic acid∖ Glutamic acid | ID: <u>XM_00449147</u> <u>3.2</u> | 99% |
|--|---------------------------------------|--------------------------------------|-----|
|--|---------------------------------------|--------------------------------------|-----|





Fig. 6: Neighbor-joining tree *Cicer arietinum* heat shock 90 kDa protein gene.

It was noted from the genotype tree diagram that the standard cultivars registered in NCBI were from countries far from Iraq and the region in general. This indicates that the current study was one of the first studies at the local level that concerned itself with the genetic characterization of chickpea calluses based on the genes of heat shock proteins HSP90, as compared with international varieties, the presence of any genetically diagnosed local chickpea cultivar was not recorded in the gene bank. This results of the current study were able to reveal *HSP*90 genes from the chickpea genetic tree based on genome sequence information available in the NCBI Gene Bank which has the potential to genetically improve tolerance to abiotic stresses.



The heat shock protein HSP90 was drawn by inserting an alignment sequence of the nitrogen base sequences of the genes of heat shock proteins *HSP90* for selected samples of chickpea callus and based on the mutations induced in the Expasy program as shown in the figure below.





Fig. 7: Conformation of protein from chickpea *Cicer arietinum* L. heat shock 90 kDa protein gene

4. Discussion

The success of the current study in finding an integrated protocol for obtaining chickpea plants by means of plant tissue culture technique is due to the ex vivo response of chickpea plants combined with the appropriateness of the selected hormonal interventions. Moreover, the need to genetically improve chickpea by obtaining cell lines resistant to environmental stresses (22). Physical shock provokes multiple responses that include a series of chemical and molecular changes,



And that multiple stress-responsive mechanisms work in concert and synergistically to avoid cellular damage (23). This is due to the increase in the construction of heat shock proteins HSP90, as cells respond to stress to increase their genetic expressions that encode for the construction of these proteins this is due to their stimulation of heat shock factors HSFs, which play an important role in activating the HSP90 gene group. The construction of shock proteins HSP90 was also stimulated when tissue cultures of soybean and Arabidopsis were exposed to a degree 40 centigrade (15). The heat shock in the current study resulted in an increase in the accumulation of specific shock proteins HSPs, and synthesis synthesis of a group of proteins is an important event to adapt to heat stress. This is due to the increase and abundance of a specific number of enzymes that stimulate the synthesis of amino acids such as 5-methyl tetrahydroptroyltri glutamate- homo cysteine methyl transferase- Cystathionine gamma- Synthase., thereonine synthase (8). Among the indicators that explain the construction of heat shock proteins HSPs is that they stimulated the activity of genetic expression and encode its construction by activating a group of genes of shock proteins HSP90, especially at temperatures of 45 ° C or less, as they provided protection for the callus from damage and restored its damaged cells to their physiological activity, and preserved the structure of damage-induced proteins (24).

In this study obtaining callus tissues that are resistant to abiotic shocks is represented by the activity of genes of heat shock proteins *HSP*90 in mitochondria of callus tissues, which have a vital role in heat tolerance through the mutations formed and activating the transcription of target genes *HSF*s. This affect the stress tolerance mechanism as they are considered a regulator. Key to signal perception, transmission and control of expression of effector genes (25).

Confirmation the diagnosis of *HSP*90 genes in callus of chickpea *Cicer arietinum* L. It proved the presence of heterogeneity at the nitrogen base level at site 250 represented by mutations R and G. A study (26) showed thmentionede discovery of induced mutations of the genes of heat shock proteins *HSP90* in rice, which showed a characteristic tolerance to HS stress. The shock proteins are able to tolerate a large numbers of mutations without undergoing significant changes in function.

The exploration of genes of heat shock proteins *HSP90* through molecular analysis of the genetic relationship between species of the genus Chickpea has a great affinity of up to 99%,



while it was found that there is a level of convergence of 83% among the other chickpea species under study, which indicates bio genetic diversity and that the standard chickpea cultivars The records in the National Center for Biotechnology Information (NCBI) were from countries far from Iraq and the region in general.

5. Acknowledgment

Thanks are due to the Department of Biology, College of Education for Pure Science, university of Mosul. Also, to all colleges in biotechnology lab.

6. References

- [1] Food and agriculture organization of the United Nations (2019). World Food and Agriculture– Statistica pocketboo. http://www.fao.org/3/ca6463en/ca6463en.pdf.
- [2] Dixit, G. P.; A. K. Srivastava and Singh N.P. (2019). Marding towards self sufficiency in chickpea. *Current Science*, 116:239-242.
- [3] Singh, R.K.; J. Jashankar; M. Muthamilarasan; S. Shweta; A. Dangi and Preasad, M. (2016). Genome – wide analysis of heat shock proteins in C4 model, foxtail millet identifies potential candidates for crop improvement under abiotic stress. *Scientific Reports*, 6: 32641.
- [4] Singh, K.B. and Saxena, M.C. (1999). Chickpea (The Tropical Agriculturalist). CTA/ Macmillan/ ICRDA. 34 PP. Macmillam Education Ltd. London, UK.
- [5] Raza, A.; A. Razzaq; S. Mehmood; X. Zou; X. Zhang; Y. Lv and Xu J. (2019). Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review. *Plants*. 8: 34.
- [6] Govindaraj, M.; S. K. P. Shetti; N. Patne and Kanatti, A. A. (2018). Breeding cultivars for heat stress tolerance in staple food crops. In: Ciffci YO, ed. Next generation plant breeding. *In Tech Open*.
- [7] Takahashi, F. and Shinozaki K. (2019). Long distance signaling in plant stress response. *Current Opirion in Plant Biology*, 47: 106-111.
- [8] Mirshra, D.; S. Shekhar; D. Singh and Chakraborty S. (2018). Regulation of Heat shock protein Responses, Heat Shock protein. National Institute of plant Genome Research. Chapter 3: 41-69.



- [9] Sotirisos, F.; R. Sascha; S. Enrico and Klaus D. S. (2015). Prospects of engineering thermo tolerance in crops through modulation of heat stress transcription factor and heat shock protein networks. *Plant cell & Environment*, 38: 1881-1895.
- [10] Waters, E. R. (2013). The Evolution function, Structure, and expression of the plant HSPs. *Journal of Experimental Botany*, 64:391-403.
- [11]Berz, J.; S. Simm; S. Schuster; K. D. Scharf; E. Schleiff and I. Ebersberger (2019). Heat stress: a databases and web server for identification and classification of heat stress transcription factors in plants. *Bioinformatic and Biology insights*, 13.
- [12] Rani, A.; P. Devi; U. Jha; K. Sharma; K. Siddique and Bayyar H. (2020). Developing climate resilient chickpea involving physiological and molecular approaches with a focus on temperature and drought stresses. *Frontiers in Plant Science*, 10: 1759.
- [13] Santisree, P.; M. P. Bhatnagar and Sharma K. (2017). Heat responsive proteome changes reveal molecular mechanism un delaying heat tolerance in chickpea. *Environmental and Experimental Botany*, 141: 132-144.
- [14]Michela, J.; Mariolina, G.; M. Elena; M. Marta; V. Babu; T. N. Henry and Nelson M. (2020). Molecular and genetic basses of heat stress responses in crop plants and breeding for incurs seed resilience and productivity. *Journal of Experimental Botany*, 71: 3780-3802.
- [15] Xu, J.; C. Xue; D. Xue; J. Zhao; J. Gai; N. Guo and Xing H. (2013). Overexpression of GmHsp90s, a heats shock protein 90 (*HSP*90) gene family cloning from soybean, decrease damage of abiotic stresses in Arabidopsis thaliana. *PLoS One*, 8(7).
- [16] Agrwal, G.; V. Garg; H. Kudapo; D. Doddamani and Pazhamala L. T. (2016). Genome wide dissection of AP2/ ERF and HSP90 gene families in five legumes and expression profile in chickpea and pigeon pea. *Plant Biotech. J.*, 10: 1-15.
- [17]Murashige, T. and Skoog F. (1962). Arevised medium for rapid growth and bioassays with tobacco tissue culture. *plant physiology*. 15: 473-497.
- [18] Al-Abasi, I. N.; M. K. Al-Mallah and Kasab Bashii B. Z. (2020). Heat shock enhancement salicylic acid biosynthesis in callus of *Calendula officinalis* L., *J. Pharm. Sci. Res.*, 12: 869-874.



- [19] Larion, A.; A. Kransc and Miller W. (2005). A standard Curve based method for relative real time PCR data processing. *Virtual Machine Bioinformatics*. 6: 62.
- [20] Koichiro, T.; S. Glen; P. Daniel; F. Alan and Sudhir K. (2013). Molecular evolutionary Genetics Analysis version 6.0 (MEGA6). *Mol. Biol. Evol*, 30:2725–2729.
- [21] Gasteiger, E.; A. Gattiker; C. Hoogland; I. Ivanyi; R. D. Appel and Bairoch A. (2003). ExPASy: the proteomics server for in-depth protein knowledge and analysis. Nucleic Acids Res. 31:3784-3788.
- [22] Macar, T. K.; O. Macar and Mart D. I. (2017). Variability in some biochemical and nutritional characteristics in desi and Turkish Kabuli Chickpea (*Cicer arietinum* L.) Types. CBU Journal of Science. 13:677-680.
- [23] Al-Whaibi, M. H. (2011). Plant heat -Shock proteins: A mini review. J. king Saud University Science, 23: 139-150.
- [24] Liu, Y.; J. Li; Y. Zhu; A. Jones; R. J. Rose and Song Y. (2019). Heat stress in legume seed setting: effects, causes, and future prospects. *Frontiers* in *Plant Science*. 10:938.
- [25] Fragkostefanakis, S.; S. Roth; E. Schleiff and Scharf K. D. (2015). Prospects of engineering thermo tolerance in crops through modulation of heat shock protein networks. *Plant cell and Environment*, 38: 1881-1895.
- [26] Yona, N. (2015). Genetic characterization of heat tolerant (HT) upland mutant rice (*Oryza sativa* L.) lines selected from rice genotypes. Master thesis, University of Agriculture Morogoro, Tanzania.

Copyright © 2022 Anwaar F AL-Taee, Dr. Jamella H Rasheed, AJRSP. This is an Open-Access Article Distributed under the Terms of the Creative Commons Attribution License (CC BY NC)

Doi: https://doi.org/10.52132/Ajrsp.e.2022.33.6